EPA Region 2 Climate Adaptation Implementation Plan

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Placeholder for Janet McCabe's Introductory Statement

2. Senior Leadership and Staffing

Region 2's leadership and staffing for climate change adaptation flows from the Region's Climate Change Workgroup structure, which consists of a senior leadership chair, Workgroup co-chairs, divisional representatives, and a senior management advisory council, as follows:

a. Senior Leadership Chair - Richard Ruvo, Director, Air and Radiation Division (ARD)
b. Workgroup Co-Chairs – Juan Gutierrez, ARD, and Joseph Siegel, Office of Regional Council
c. Climate Change Workgroup Divisional Representatives: Gavin Lau (ARD), Alex Rivera (CEPD), Hector Velez (CEPD), Kathleen Malone-Bogusky (ECAD), Stephanie Lamster (LCRD), Dale Carpenter (LCRD), Lampros Bourodimos (LSASD), William Sy (LSASD), Kwong Cho (MSD), Joseph Siegel (ORC), Anhthu Hoang (ORC), Tasha Frazier (PAO), Natalie Loney (PAO), Mike Basile (PAO), Jessica Mollin (SEMD), Diane Salkie (SEMD), Anne Rosenblatt (SPO), Rabi Kieber (SPO), Grant Jonathan (SPO), Nicole Tachiki (WD), Irene Purdy (WD)
d. Senior Management Advisory Council: Matthew Laurita (ARD), Carmen Guerrero (CEPD), Dore LaPosta (ECAD), Judy-Ann Mitchell (LCRD), Anahita Williamson (LSASD), Linda Timander (MSD), Paul Simon (ORC), Sabina Byck (PAO), Chloe Metz (SEMD), David Kluesner (SPO), Javier Laureano (WD)

We thank all the above for their role in producing this Plan. We are also grateful to our former Climate Change Workgroup members who contributed to this Plan: Janice Whitney, Esther Nelson, and Sofia Olivero-Lora.

3. Climate Vulnerability Assessment

INTRODUCTION

Climate change, interacting with changes in land use and demographics, will affect important human facets in the United States, especially those related to human health, communities, and welfare. The challenges presented by population growth, an aging population, migration patterns, and urban and coastal development will be affected by changes in temperature, precipitation, and extreme climate-related events. According to the International Panel on Climate Change (IPCC), the global average temperature over the 21st century is expected to increase between 3.5 and 7°F. This large range is due to the uncertainties in both the future greenhouse gas (GHG) concentrations and the sensitivity of the climate system to GHG emissions. The greatest warming is expected to occur over land and in the high altitudes of the northern hemisphere where local warming may exceed 15° F. In these regions, winter warming is expected to be greatest (NPCC 2019). Hurricane wind speeds, rainfall intensity, and storm surge levels are likely to increase. Other changes include measurable sea level rise and increases in the occurrence of coastal and riverine flooding (Frankson et al., 2022). Given the diverse geography covered by Region 2 and the varied environmental programs that EPA implements in this region, climate change presents a broad array of challenges to the achievement of our mission to protect human health and the environment. While the challenges vary between the continental states (NY/NJ) and the tropical islands of Puerto Rico (PR) and the United States Virgin Islands (USVI), there are common coastal concerns for the Region as a whole.

This regional vulnerability assessment builds on the vulnerability assessment contained in Region 2's 2014 Adaptation Implementation Plan and is divided into two sections: (1) Background on Region 2's changing climate and vulnerabilities we face; and (2) Region 2's Vulnerability Assessment based on programmatic expertise. It contains information specific to communities and individuals that are particularly vulnerable to climate change impacts, such as low-income communities, communities of color, children, the elderly, and Indian Nations.

The information on climate change impacts is derived from authoritative sources and scientific literature, including major climate assessments produced by the U.S. Global Change Research Program, such as the Fourth U.S. National Climate Assessment, and the Intergovernmental Panel on Climate Change. It includes broad trends and principles related to climate change vulnerability as well as Region-specific information. The program-specific section of the vulnerability assessment sets forth the Region's assessment of the risks that those climate change impacts pose to the programs that Region 2 implements and to our facilities, assets and day-to-day operations. This assessment of our programmatic risks and vulnerabilities should be viewed as a living document that will be updated as needed and when possible, to account for new knowledge, data and scientific evidence.

CHANGING CLIMATE

PRECIPITATION AND INLAND EFFECTS

Nearly all climate models predict changes in precipitation patterns. In New York and New Jersey, precipitation is expected to increase in intensity during rainfall events and areas will experience hotter and drier periods between those events (New York City Housing Authority, 2021). Similarly, the Caribbean may see less frequent but heavier storm events with more severe drought periods (Gould et al., 2015). In New York City, it is projected that today's 50-year rainstorm will be the 5-year rainstorm of 2050. The City's stormwater systems were not built to withstand such events, and there is a need to find alternative ways of managing the larger volumes of rainwater that will occur more frequently (New York City Housing Authority, 2021). In the New York area, average precipitation is projected to increase up to 15% in southern New York and up to 20% in northern New York by 2050. Much of this increase is projected to fall in the winter months (Frankson et al., 2022), and more likely to fall as rain instead of snow. In upstate New York, the changing balance between rain and snow has already reduced snowpack and, in addition, many areas have experienced severe flooding from extreme rainfall events like Hurricane Irene. Warming temperatures have led to decreases in ice cover on lakes and rivers.

In the Great Lakes region, which includes the Eastern Basin of Lake Erie and the Lake Ontario basin in upstate NY, reduction in ice cover will lead to cold air moving over open water that would have otherwise been frozen. This will increase evaporation, leading to heavier and more frequent lake effect snow. Rising atmospheric temperatures will cause annual spring runoff due to snowmelt to occur up to two weeks earlier in the year. This change will decrease the amount of water that would normally reach the area later in the year and stresses the ecosystems that depend on the water during the summer months (USGCRP 2009). Studies also predict a decrease in the Great Lakes water levels due to increased evaporation and decreased runoff from snowmelt. This has implications for energy generation, drinking water intakes, and downstream ecosystems (NYSERDA 2011). Rising air temperatures also increase water temperatures. In lakes and reservoirs, warmer surface water temperatures reduce the frequency of turnover with cooler bottom waters which results in increased periods of stratification (USGCRP 2009). Increased stratification isolates the warm layers of water. These warm layers have diminished capacity to retain dissolved oxygen (DO), which is critical to supporting life in aquatic ecosystems (NYSERDA 2011). While hypoxia in Lake Ontario and the Eastern Basin of Lake Erie is currently limited to a small number of local embayments, this could change with future effects of climate change, i.e., continued increases in air and surface water temperatures.

In contrast to increased evaporation and the potential for low water conditions, Lake Ontario is also the most downstream of the five Great Lakes and as such precipitation falling across the entire Great Lakes Basin affects water levels in Lake Ontario and the St. Lawrence River. In years with above-average precipitation across the Great Lakes Basin, Lake Ontario is susceptible to high water and flooding. This was the case in 2017 and 2019 when record high water levels occurred in Lake Ontario, see: https://www.ijc.org/en/loslrb/library/publications.

Climate change trends and models predict more extremes in precipitation levels across the Great Lakes Basin – higher highs and lower lows – as a result, Lake Ontario is likely to experience both high water and flooding events as well as low water effects along the shoreline. Overall, climate models predict more precipitation in the Great Lakes Basin (NOAA, 2021).

Variability creates its own challenges and vulnerabilities making it more difficult to model and predict nutrient and other dynamics on a lake-wide basis. This in turn affects our ability to manage and protect lake-wide resources and ecosystem services from water quality and chemical contamination to shoreline habitat and species. Multiple uses of the Lake are affected by variability and vacillations between extremes (extreme high water and low water conditions) from serving as a source of high-quality drinking water to serving as an important recreational fishery and a key driver for local lakeshore economies in New York State.

HURRICANES

Hurricanes are a significant climate change-related vulnerability in Region 2. Superstorm Sandy and Hurricane Irene had major consequences for New York and New Jersey in 2012 and 2011, respectively. Increased frequency and magnitude of hurricanes have been observed in the Caribbean. A total of twelve hurricanes and eight tropical storms hit the northern Caribbean between 2004 and 2007, including some of the most powerful storms on record (Burke et al., 2011). The 2017 Atlantic season alone had 17 named storms and 10 hurricanes (NOAA 2017), including Hurricanes Irma and Maria, which caused catastrophic damage to Puerto Rico and the U.S. Virgin Islands. The destructive power of tropical storms and hurricanes in the Atlantic has notably increased and is associated with warmer sea surface. Climate simulations indicate a potential decrease in the frequency of tropical storms and hurricanes in the Caribbean and North Atlantic, but an increase in frequency of intense/extreme events (Puerto Rico Climate Change Council, 2013). In a 2019 analysis, Hurricane Maria was noted to be the single largest rainfall event of the 129 storms since 1956 and similar storms are more likely to occur (Keellings & Ayala, 2019). Also based on an OIG report, EPA Region 2's Hurricanes Irma and Maria response efforts in Puerto Rico and U.S. Virgin Islands show the need for improved planning, communications, and assistance for small drinking water systems (EPA, 2020). In addition, sediment impacts on marine ecosystems due to stormwater runoff in Puerto Rico and the U.S. Virgin Islands are a concern that has been studied for some time(Castillo et al., 2012; Stormwater Report, 2021). Hurricane Maria not only caused runoff of sediments into the marine ecosystems but also destroyed roads and critical infrastructure through washouts and landslides. Moreover, the strong winds plunged vast swaths of the Islands into darkness by compromising the power grid and decimated residences, businesses, and the communication infrastructure Other impacts from hurricanes in Region 2 are discussed throughout this assessment.

OTHER EXTREME EVENTS SUCH AS TORNADOES AND SEVERE THUNDERSTORM

New Jersey and New York have also experienced tornadoes, heavy rain, quarter-size hail, and powerful wind that battered parts of Long Island, New York City and New Jersey in 2021. Observed and projected future increases in certain types of extreme weather, such as heavy rainfall and extreme heat, can be directly linked to a warmer world. Other types of extreme weather, such as tornadoes, hail, and thunderstorms, are also exhibiting changes that may be related to climate change, but scientific understanding is not yet detailed enough to confidently project the direction and magnitude of future change (NCA 2018). This potential increase of thunderstorms, lightning, heavy rain, hail, and tornadoes make it clear that threats from climate change are clear and present in the Mid-Atlantic (2020 NJ Scientific Report on Climate Change).

SEA LEVEL RISE, WATER TEMPERATURE AND pH

Climate change also impacts our marine resources, estuaries, and coastal regions. Currently, sea levels are rising an average of 0.86 to 1.5 inches per decade, as measured by tide gauges, with an average of 1.2 inches per decade since 1900. Before the Industrial Revolution, increases in sea level rise ranged from 0.34 to 0.43 inches per decade, mostly as a result of land subsidence, which is the gradual sinking of an area of land (NPCC 2010). While global sea level is projected to rise one to four feet by 2100, New York's sea level is expected to rise more than the global projection (Frankson et al., 2022). For the Long Island and New York City shorelines, models predict a rise of 7-12 inches by 2050 and 19-29 inches by 2080. When considering a rapid ice melt scenario in the arctic, sea levels could rise by as much as 58 inches by 2080 (Horton et al., 2014). New Jersey will likely experience a 1.4 to 3.1-foot increase in sea level by 2070 under a moderate emissions scenario (2020 New Jersey Scientific Report on Climate Change). The New York City Panel on Climate Change (NPCC, 2015) sea level rise projections provide the current scientific basis for NYC's scientific decision making and planning. Unfortunately, since the IPCC (2013) and NPCC (2015) reports, recent observations show increased glacier and ice sheet losses leading to rising sea levels. Recent modeling interactions between oceans, atmosphere, and ice sheets suggest a higher global mean sea level rise (GMSLR) by 2100 than previously estimated and will pose serious adverse consequences to people and infrastructure in low-lying neighborhoods (NPCC, 2015). Estimates for Puerto Rico sea level rise range from 0.20 to 1.87 feet by 2060 and 0.40 to 5.59 feet by 2110. Consequences of this sea level rise in combination with storm surges and poor management of coast lines can be already observed in the form of increased coastal erosion and retreat of coastline in some parts of the island by up to 3.3 feet per year (Puerto Rico Climate Change Council, 2013).

Freshwaters and marine waters are all expected to see increases in water temperature with higher air temperatures. Some models predict an ocean temperature increase of 1.8 – 2.5°F for nearshore waters by 2050 (NYSERDA 2011). Higher ocean temperatures cause thermal expansion, which was responsible for 50% of sea level rise during 1971–2018 (IPCC 2021).

When atmospheric carbon dioxide (CO_2) increases, more CO_2 is dissolved in the ocean, decreasing the pH of the water, and creating an acidic environment that dissolves the hard shells of corals, shellfish, and smaller organisms (Doney, 2006; Wood at al., 2008). This process, called ocean acidification, also decreases the availability of calcium carbonate ($CaCO_3$), a building block for the shells and exoskeletons of many marine organisms. Although dissolution of CO_2 in oceans is a natural process, the current rate of ocean CO_2 dissolution is unprecedented, with serious implications for the marine food chain and ocean ecosystems. In the Caribbean, the sea surface temperatures (SST) have risen 2.7 °F over the last century and studies indicate that the warming trend should continue in the 21st century with SST exceeding the threshold for coral bleaching one-third of the year (Puerto Rico Climate Change Council, 2013).

HUMAN HEALTH

Climate-related changes in weather patterns and their associated impacts on air quality, water quality, and incidence of vector borne diseases are affecting the health and well-being of those who live in Region 2 in a number of ways (NCA4, Ch.18).

Climate change is beginning to accentuate the disparities already evident in the American health care system. Many of the expected health effects will fall disproportionately on the poor, the elderly, the very young, the disabled, and the uninsured (NCA4, Ch. 14).

Urban areas are especially prone to increased morbidity and mortality among the elderly and small children due to heat waves and poor air quality from higher temperatures and dry conditions (New York City Housing Authority, 2021). In addition to air pollution and heat-related impacts on health, extreme weather events increase the risk for injuries and loss of life during storm events where high winds and fast-moving flood waters are involved.

Moreover, flood waters can expose people to harmful environmental contaminants. This includes people who utilize onsite wastewater treatment systems or live near industrial sites or facilities that store or contain hazardous materials. For coastal and waterfront communities, heavy storms that cause storm surges overwhelm or damage wastewater and drinking water treatment systems with high water volumes of salt water. This can result in communities being inundated with sewage and industrial waste-contaminated waters which can cause gastrointestinal and respiratory illnesses. These flooding events are likely to increase in frequency and magnitude with more frequent heavy rainfall events under climate change (NYSERDA 2011). Unfortunately, communities most impacted by this flooding risk are also those least able to relocate from flood-prone areas, and therefore are more likely to be impacted by weather events that could disrupt the drinking water and electrical supply as well as damage plumbing and electrical systems at homes and businesses. In PR and the USVI, the potential for adverse human health impacts and increased incidences of vector-borne diseases are anticipated (CDC, 2020). In addition, warmer winters are associated with higher rates of ice-related drownings in the colder portions of our Region (Sharma, Blagrave 2020).

Climate change impacts can also have adverse mental health effects. In the Northeast, flooding from storm surge, sea level rise and extreme precipitation events associated with climate change can lead to lasting mental health consequences including anxiety, depression, and post-traumatic stress disorder, which were observed following Superstorm Sandy (NCA4, Ch. 18, 2018). Mental health impacts in the Caribbean are also notable, as many survivors of the 2017 hurricane season have experienced a high degree of psychological trauma. (NCA4, Ch. 20, 2018). Extreme heat and climate-induced migration are other climate change-related sources of adverse mental health impacts. (NCA4, Ch. 18, 2018).

The National Research Council 2011 report, *Climate Change, the Indoor Environment, and Health,* addresses the impacts that climate change may have on the indoor air environment and the resulting health effects. Extensive research was conducted regarding how climate change affects the outdoor environment, how the outdoor environment affects indoor environments under different climate conditions, and how indoor environments affect occupant health. Results reveal that when there is increased outdoor concentrations of pollutants, the indoor air quality is also negatively impacted. For example, due to increased outdoor concentrations of pollutants caused by alterations in atmospheric chemistry or atmospheric circulation, indoor concentrations of pollutants can also become elevated. Other indoor health impacts can result from excessive moisture and mold, flooding, infectious agents and pests, and thermal stress (Institute of Medicine, 2011).

AQUATIC ECOSYSTEMS

Changes in climate have direct and indirect impacts on all aquatic ecosystems, significantly impacting biodiversity within freshwater, coastal and marine systems. As rivers and streams get warmer,

warmwater fish are expanding their range to areas previously inhabited by coldwater fish, while trout and salmon species are slowly losing their habitat (Karl et al., 2009). The capacity of wetlands ecosystems to absorb floodwaters is diminishing, while coral reefs can no longer protect coasts from storm surges. Warming waters encourage spread of pathogens, parasites and disease significantly impacting oyster, fish and coral colonies (Cohen, Lee 2018).

VULNERABLE POPULATIONS

Although climate change will affect all residents of Region 2, the risks associated with climate change are not experienced equally. The impacts of climate change on an individual depends on many factors including the degree of exposure, individual sensitivity to exposure, and the individual or community-level capacity to recover. (USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II). Due to the cumulation of many factors, low-income communities and communities of color, children and older adults are often overburdened with poor environmental conditions and are likely to be disproportionately affected by the impacts of climate change. This adaptation plan prioritizes actions to address the disproportionate share of climate-related risks experienced by these communities.

One of the principles guiding EPA's efforts to integrate climate adaptation into its programs, policies, and rules calls for its adaptation plans to prioritize helping people, places and infrastructure that are most vulnerable to climate impacts, and to be designed and implemented with meaningful involvement from all parts of society. Administrator Regan noted that "(T)he impacts of climate change that we are feeling today, from extreme heat to flooding to severe storms, are expected to get worse, and people least able to prepare and cope are disproportionately exposed…." According to EPA's *Climate Change and Social Vulnerability in the United States: A Focus on Six Impact Sectors* report:

- Black and African American individuals ages 65 and older have the most disproportionate risk with the highest projected increases in premature mortality from climate-driven changes in PM2.5
- Black and African American individuals are projected to face higher impacts of climate change for all six impacts analyzed (Air Quality & Health; Extreme Temperature & Health; Extreme Temperature & Labor; Coastal Flooding & Traffic; Coastal Flooding & Property; and inland Flooding & Property) in this report, compared to all other demographic groups. For example, under conservative estimates with 2°C (3.6°F) of global warming, Black and African American individuals are 34% more likely to currently live in areas with the highest projected increases in childhood asthma diagnoses. This rises to 41% at 4°C (7.2°F) of global warming. Additionally, these populations are 40% more likely to currently live in areas with the highest projected increases in extreme temperature related deaths. This rises to 59% under 4°C of global warming.
- Hispanics and Latinos have high participation in weather-exposed industries, such as construction and agriculture, which are especially vulnerable to the effects of extreme temperatures. With 2°C (3.6°F) of global warming, Hispanic and Latino individuals are 43% more likely to currently live in areas with the highest projected reductions in labor hours due to extreme temperatures. With regards to transportation, Hispanic and Latino individuals are about 50% more likely to currently live in areas with the highest estimated increases in traffic delays due to increases in coastal flooding.
- Low- income individuals are more likely to live in areas with: the highest increases in childhood asthma diagnoses from climate-driven changes in PM2.5; the highest percentage of land lost to inundation; the highest increases in mortality rates due to climate-driven changes in extreme

temperatures; the highest rates of labor hour losses for weather-exposed workers due to extreme temperatures; and the highest increases in traffic delays associated with high-tide flooding.

As a note, most of the summary findings focus on national-level results for scenarios with 2°C of global warming (relative to the 1986-2005 average) or 50 cm of global sea level rise (relative to the year 2000). Currently, wide disparities in the adaptive capacity exist among communities within Region 2. Without addressing this and developing strong adaptation measures, climate-related social, economic, and health impacts will become more prevalent as the frequency and severity of extreme climate events such as heat waves, flooding, and severe storms increase. This is especially true in vulnerable communities that are least able to anticipate, cope with, and recover from the impacts.

For the past decade, Region 2 communities from the Caribbean to the Northeast have faced summers with increasing numbers of days over 32°C (90° F) (CDC, 2021). Low-income seniors are at highest risk for heat-related health impacts. From 2010 to 2019, heat stress deaths in New York City were highest among people aged 80 and older (City of New York, 2021). When power producers attempt to meet the increased demand from these high heat days, they put the community at risk for power outages which creates additional hardships. Furthermore, climate change may exacerbate existing problems with aging infrastructure such as energy and transportation infrastructure, as well as waste and drinking water facilities which may potentially result in negative health consequences. As a note, most of our current infrastructure systems were not designed to withstand projected weather extremes and other impacts of climate change.

With sea level rise and the projected increase in the frequency and intensity of storms, overburdened and underserved communities in Region 2 will experience a spectrum of health-related impacts from exposure to mold and mildew to trauma and to lack of clean drinking water immediately after a disaster. In areas where flooding occurs and damages electrical systems and necessitates the use of residential generators, we expect to see increased health problems related to carbon monoxide poisoning as some residents do not know to ensure proper ventilation when operating generators. Flooding of industrial and environmental infrastructure presents unique challenges to the most vulnerable communities. For example, during and after Superstorm Sandy, the Shinnecock Nation, which is located in a lowland coastal area of the Long Island Sound, was faced with the loss of drinking water because floodwaters infiltrated their private drinking water wells. Similarly, the low-income community of the Ironbound section in Newark, New Jersey, was inundated with floodwaters that carried raw sewage and treatment chemicals from the nearby sewage treatment plant and industrial operations.

This Implementation Plan delineates priority actions to be taken to address a number of identified climate risks that are of particular relevance to vulnerable populations and communities. In addition to the priority actions in Section 3, below, that are specifically oriented to these communities, Region 2 will consider vulnerable populations and communities when implementing the other priority actions and work in partnership with these communities to increase their adaptive capacity and resilience to climate change impacts. These efforts will be informed by the experiences EPA Region 2 had in supporting recovery efforts with previous extreme weather events (e.g., Superstorm Sandy and Hurricanes Irma and Maria) and the subsequent recovery efforts. Meaningful engagement also will help EPA to further understand the disproportionate vulnerabilities and cumulative impacts these communities face.

COMMUNITIES IN PUERTO RICO AND THE US VIRGIN ISLANDS

Many communities that are already overburdened on the islands of PR and the USVI are especially vulnerable to the impacts of climate change. Climate change impacts these coastal communities more broadly due to effects on infrastructure and mobility, and can compromise limited water resources, sensitive ecosystems and overall resilience due to natural hazards and the location of large urban centers near the coastlines. Additionally, their limited congressional representation and select programmatic factors result in diminished resources for the territories (e.g. San Juan, Charlotte-Amalie) and isolation (Gould et al. 2018). The threats from climate change to this portion of the Caribbean include the potential increase in sea level of at least 15.7 inches based on a linear trend of observed sea level rise (PRCCC 2012), increase in the average annual temperature ranging between 3.5 - 5 °F, (USGCRP 2009) and a 5 to 20% decrease in precipitation by the end of the century (USGCRP 2009). Other impacts include the formation of more intense hurricanes and an increase in ocean temperature and acidity (USGCRP 2008). The impacts from these threats will cause a myriad of adverse effects to PR and the USVI including: increases in coastal inundation, storm surges, water pollution from coastal flooding and erosion, landslides, damage to vital infrastructure (e.g. solid waste infrastructure, water infrastructure, energy grid, hospitals, transportation, communications), settlements, and facilities that support the livelihood of near shore and low lying communities; compromised coastal water resources from land based sources impacting coral reefs; and changes in fisheries and other marine-based resources (Gould et al., 2015; CDC, 2020).

INDIAN NATIONS

Region 2 is home to eight Federally-recognized Indian Nation communities, all located in NY State. EPA values its unique government-to-government relationship with Indian Nations in planning and decision making. Region 2's government to government treaty-based relationship has been established over time and is further supported by the 1984 EPA Policy for the Administration of Environmental Programs on Indian Reservations and the 2011 Policy on Consultation and Coordination with Indian Nations. These policies recognize and support the sovereign decision-making authority of Indian Nation governments.

Under the Constitution, treaties with tribal and Indian Nations are part of the supreme law of the land, establishing unique sets of rights, benefits and conditions for the treaty-making tribes and Nations who were forced to cede millions of acres of their homelands to the United States, in return for recognition of property rights in land and resources as well as federal protections. Tribal/Indian Nation treaty rights have the same legal force and effect as federal statutes and they should be integrated into and given the fullest consideration throughout EPA's collective work. Reserved rights are the rights tribes/Nations retain that were not expressly granted to the United States by tribes/Nations in treaties. Treaty and reserved rights, including but not limited to the rights to hunt, fish and gather, may be found both on and off-reservation lands. Agencies should consider treaty and reserved rights in developing and implementing climate adaption plans in order to protect these rights and ensure the Agencies meet their legal and statutory obligations and other mission priorities as we work to combat the climate crisis.

In September 2021, EPA joined 16 other federal agencies in signing a Memorandum of Understanding (MOU) that committed those parties to identifying and protecting tribal/Indian Nation treaty rights early in the decision-making and regulatory processes. Accordingly, EPA will consider and protect treaty and reserved rights in developing and implementing climate

adaptation plans through strengthened consultation, additional staff training and annual reporting requirements.

Partnering with Indian Nations to develop adaptive capacity is a priority for the EPA. Nations are particularly vulnerable to the impacts of climate change due to the integral nature of the environment to their traditional lifeways and culture. The lands, waters and natural resources of the Nations hold sacred cultural significance and are also vital in maintaining these communities' social, health and economic wellbeing. There is a strong need to develop adaptation strategies that promote sustainability and reduce the impact of climate change on Indian Nations.

EPA engaged with the Nations to listen to their concerns regarding the impacts that climate change is already having on their communities. Nations identified some of the most pressing issues as flooding and erosion, temperature change, drought, various changes in access to and quality of water and impacts to biodiversity. The Nations in Region 2 are likely to be impacted by similar vulnerabilities discussed in other portions of this vulnerability assessment. In addition to those vulnerabilities mentioned throughout, Nations in Region 2 have indicated, as discussed below, that there are ecological as well as cultural activities that are vulnerable to the effects of climate change, directly affecting many of the cycles of the natural world.

The Nations have noted for generations a change in the composition of species, introduction of invasive species and reduction in species and habitat biodiversity. This biodiversity is important to the Nations both culturally and ecologically. For instance, the Nations have noted a shift in tree species in forests due to climate change. The change in forest tree species may not be moving at a rate as fast as that of climate change and therefore could lead to diminishing forest size. This has resulted in an increased reliance on the planting by Indian Nation communities of tree species that are more typically found in southern climates like the Carolina region of the U.S. These changes in composition have impacted habitat quality. Moreover, there is a growing concern that climate conditions are affecting many species of culturally significant trees such as the maple tree, causing an infestation of pests, insects, and fungi attacks. Additional impacts to biodiversity include the infestation of gypsy moths in forests in the territories due to drought conditions caused by climate change. The Nations emphasized the significant impact that climate change has on the well-being of the natural world and animal species.

Being primarily agricultural communities, the impacts of climate change on growing conditions and harvesting are of particular concern to the Nations. Erratic weather patterns caused by climate change have, in some cases, negatively affected harvest yields and conditions for gardening and impacting both agriculturally important and culturally important crops. Flooding, from intense precipitation events, for instance, has impacted the ability to grow and harvest crops such as corn. The harvesting of culturally important crops such as maple syrup and wild strawberries as well as the undertaking of ceremonies to celebrate their harvest and medicinal purposes have also been affected by the changing climate. The traditional timing for harvesting crops depends largely upon the weather. If there is a cold winter with a lot of snow, the Nations will have a good harvest of maple syrup in the spring. If there is a mild winter with limited precipitation, the maple syrup is not as plentiful and even in some cases, not available. The wild strawberry plant has unique nutritional and medicinal qualities that contribute to blood purifying and blood building. In particular, the berries, leaves and roots of the wild strawberry plant contribute to a variety of women's health concerns and pregnancies. The mid to late spring is traditionally the time that the wild strawberries come into being. But with changing climate, they now grow in the summer months, or are not as bountiful as previous years.

The trends of warming temperatures and a shorter, milder winter means that a stable winter season is no longer reliable, impacting ice cover and snow accumulation. A decrease in stable ice cover has impacts on ecology, ice fishing, flooding and public safety as in some river communities the ice is used as a transportation corridor. Steady snow is also relied upon for historically important cultural traditions such as the "snow snake" game that has been played for centuries. This game is not played as much as in previous generations due to the lack of snow during the winter months. Snow and ice melt also has the potential to affect flooding during other times of year. Extreme storm and precipitation events create their own hazards including flooding, shoreline erosion, and higher water levels along coasts and in riverine areas.

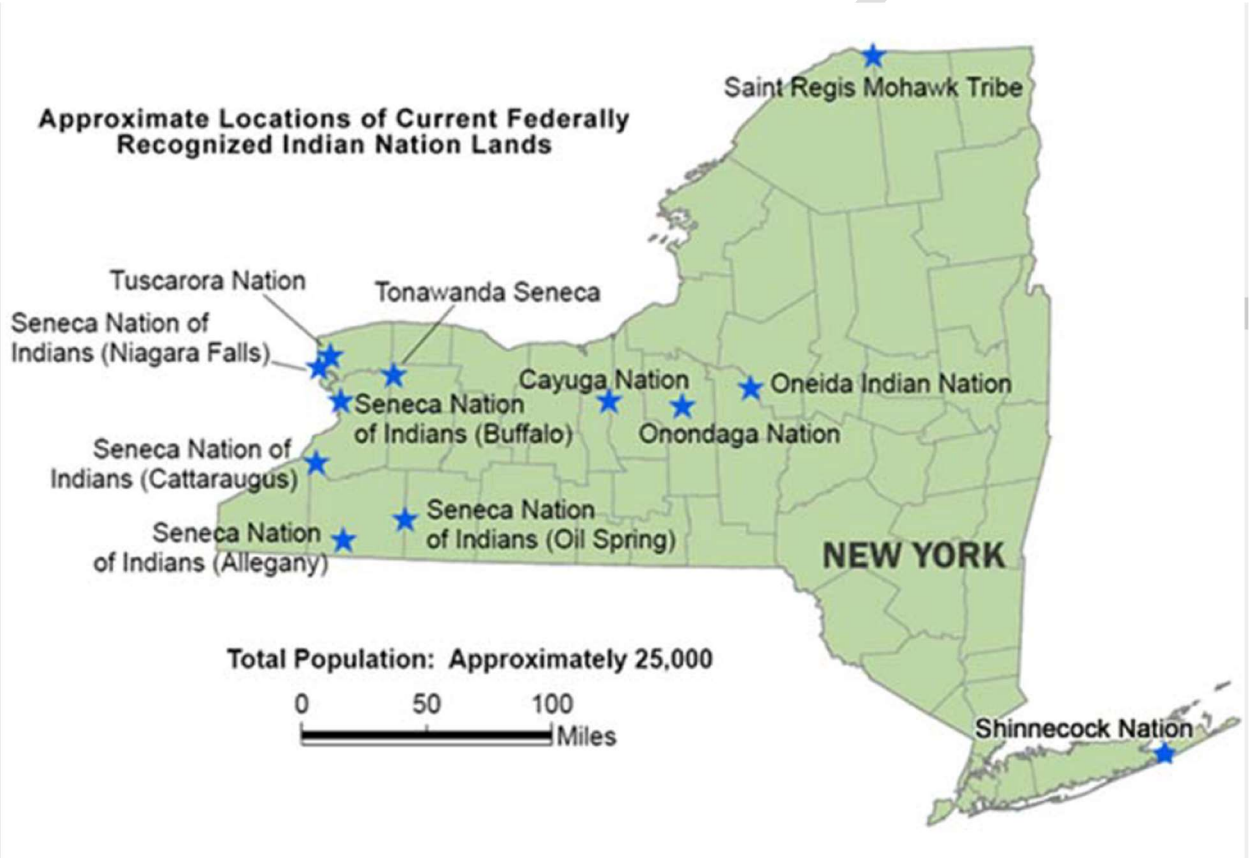
The undertaking of cultural activities such as ceremonies held in Nations' longhouses have significantly been impacted with the unpredictable climate. For example, the Thunder Dance (or "Welcoming of our Grandfathers") is typically held two times per year, with the first being held during the spring when one to three thunderstorms are heard and the second ceremony held during a dry period when rain is needed for crops. The Nations thank the Thunderers or Grandfathers in the ceremony for returning again that year and for continuing to perform their responsibility of providing rain and fresh water, renewing the lakes, rivers, streams and wells. With the changing climate however, thunder is now common during rain and snowstorms in the winter months (December thru February). Likewise, the ceremonies for the Strawberry, String Bean, and Green Corn are determined based upon the time for harvest, which more often depends upon the unpredictable climate conditions. Impacts to cultural ceremonies through the whole calendar are being seen. Other cultural and economic activities such as fishing and hunting of wild game have also been impacted by changes in streams, other fishing waters, and natural habitats.

Tribal Nations have had to deal with historical traumas and stress associated with colonization and loss of their traditional lands and way of life. These past traumas and stress continue to impact their present-day health and well-being and are exacerbated by climate change impacts and concerns. The American Psychiatric Association (APA) recognizes that climate change poses a threat to mental health and those with existing stresses are disproportionally impacted.

The Nations have historically had to adapt to changing environments, however climate change presents a new set of challenges to the adaptive capacity given the Nations' dependence on and interconnected relationship with the natural environment.

The Nations challenged EPA to pivot from prioritizing identifying vulnerabilities to develop implementation plans for adaptation and mitigation actions as well as coordinate climate change activities among federal agencies so that resources are better leveraged, and administrative burdens are reduced. Section 4 of this Plan (Priority Actions) identifies specific steps that will be taken to partner with tribal governments on an ongoing basis to increase their adaptive capacity and address their adaptation-related priorities. These collaborative efforts will benefit from the expertise provide by our tribal partners and the Traditional Ecological Knowledge (TEK) they possess. TEK builds on Traditional Cultural Knowledge (TCK) and is a valuable body of knowledge in assessing the current and future impacts of climate change and has been used by Nations for millennia as a valuable tool to adapt to changing surroundings. Consistent with the principles in the 1984 Indian Policy, TEK is shared at the discretion of the Nations and is viewed as a complementary resource that can inform planning and decision-making.

Networks and partnerships already in place will be used to assist Nations with climate change issues, including Regional Tribal Operations Committees, the Institute for Tribal Environmental Professionals (ITEP), and EPA's Indian General Assistance Program (IGAP). Additionally, efforts will be made to coordinate with other Regional and Program Offices in EPA, since climate change has many impacts that transcend media and regional boundaries. Transparency and information sharing will be a focus, in order to leverage activities already taking place within EPA Offices and tribal governments. Additionally, through interagency collaboration with other federal agencies, EPA can coordinate climate change efforts to best address the Nation's needs.



CLIMATE CHANGE-RELATED CONFLICT AND COLLABORATION CHALLENGES

Climate change is a threat multiplier for conflict due to impacts such as economic shocks and displacement (World Bank 2018). Following Superstorm Sandy, over 1,400 cases were filed in the Eastern District of New York related to flood and wind insurance claims. The overwhelming number of cases led to the Eastern District's establishment of the Sandy Mediation Program which resulted in many settlements during 2014-2016 (Pollack, Reyes 2018). Impacts from climate change can also lead to administrative and civil court litigation related to EPA's authorities. Conversely, EPA can use its programs and authorities to build resilience in a manner that will prevent environmental and human health consequences from climate change hazards that lead to disputes.

Creating effective solutions to climate impacts often requires involvement of multiple stakeholders which can present complex process challenges. Despite such challenges, engaging stakeholders in climate change adaptation planning can prevent conflicts between stakeholders and the government (UNFCCC PCCB 2019). Federal agencies have encountered barriers to making efficient progress on their climate-related initiatives due to the challenges inherent in engagement and collaboration (DuPraw, Bonini 2021). Such challenges include difficulties in establishing and managing constructive dialogue, lack of follow-through on action items, and an inability to find common ground. (DuPraw, Bonini 2021). Collaborative engagement of communities impacted by climate change in all phases of adaptation planning and implementation was identified by environmental justice stakeholders as a critical need in the New York region (NYPCC 2019). EPA has provided impartial third-party facilitators and mediators to overcome barriers and assist parties seeking to collaborate on climate change-related efforts and resolve climate change-related disputes. EPA Region 2's Environmental Collaboration and Conflict Resolution program works closely with the Conflict Prevention and Resolution Center in EPA's Office of General Counsel and also has a Regional Facilitator Network. These entities have been sources of facilitators and mediators on climate-related matters.

PROGRAMMATIC VULNERABILITIES TO CLIMATE CHANGE

This section of the vulnerability assessment focuses on the climate change-related vulnerabilities to the programs and authorities administered by EPA Region 2. They align with the five broad categories of vulnerabilities in the Agency's October 2021 Climate Adaptation Action Plan: (1) Air Quality; (2) Water Quality; (3) Contaminated Sites; (4) Chemical Safety and Pollution Prevention; and (5) EPA's Facilities and Operations.

1. AIR QUALITY

TROPOSPHERIC OZONE POLLUTION

Various studies project that the annual average 8-hour maximum daily tropospheric ozone levels could increase between 2 and 5 parts per billion across the eastern U.S. between the 2000s and 2050s due to climate change (Stowell, et. al 2017). The projected increase in daily maximum ozone is approximately 2-7% of the 2015 8-Hour Ozone National Ambient Air Quality Standard (NAAQS) and could lead to an increased number of daily NAAQS exceedances[1]. The potential lengthening of the ozone season has also been projected (EPA ARC-X). Region 2 States (New York and New Jersey) are in the Ozone Transport Region, which indicates the sensitivity of the area to increased tropospheric ozone concentrations. The Jamestown, NY, NYC metro and Philadelphia metro areas currently violate the 2008 8-hr ozone NAAQS. The NYC metro and Philadelphia metro areas currently violate the 2015 8-hr Ozone NAAQS.

The projected ozone impacts of climate change may make it more difficult for New York and New Jersey to meet existing and future Ozone NAAQS. Sources in or upwind of the Region may be required to

[1] The 2015 8-Hour Ozone NAAQS is 0.070 ppm annual fourth-highest daily maximum 8-hour concentration averaged over 3 years.

implement additional control measures or emissions controls for ozone precursors. EPA's air programs would oversee states' efforts to develop State Implementation Plan (SIP) revisions to address the issue.

PARTICULATE MATTER (PM)

WILDFIRES

Though wildfires are not common in Region 2, they have been known to occur in the Pinelands region of central/southern NJ, NJ Meadowlands and in Staten Island, NY. The risks of wildfire occurrences could be enhanced by climate change-induced effects such as higher temperatures, decreased soil moisture, and longer and more numerous periods of drought (IPCC 2014, NCA4 2018). All these factors could increase the number, length, and size of wildfires. Large scale wildfires in the Western US and Canada have recently impacted the air quality in the Eastern US. In July 2021, National Oceanic and Atmospheric Administration (NOAA) satellites identified that wildfire smoke from the Western US was impacting the entire US and Canada.

The projected particulate impacts from wildfires could, but are not likely to, hinder areas in Region 2 from meeting or maintaining compliance with the PM NAAQS, but may lead to an increased number of unhealthy air quality days. Region 2's air program would oversee states' efforts to develop exceptional air quality events demonstrations and SIP revisions if wildfire events lead to issues in complying with the PM NAAQS.

OTHER SOURCES OF PM AIR EMISSIONS

An increase in extreme weather events, which in the case of storms could include strong winds and/or heavy precipitation, increase the risk of disrupting energy delivery to many areas in Region 2. For example, electrical and natural gas distribution could be disrupted by downed trees and flooding. Extended periods with energy delivery disruption in cold seasons could lead to increased use of alternative heating fuels such as wood or backup generators. Residences which rarely use fireplaces could begin using them in a manner that does not reflect best practices. Using wood for heating that has not been seasoned properly or using fireplaces improperly increases the amount of wood smoke emissions from wood burning devices, which can have negative impacts on human health and air quality. Occupants of indoor environments where wood is burned could be exposed to wood smoke. A major health threat from smoke comes from fine particles, also known as particulate matter or particle pollution (EPA). Particle pollution has been linked to premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing (EPA). The increased PM could also affect an area's ability to comply with the PM NAAQS, which could have regional health impacts. The use of backup generators during periods of energy disruption could also negatively impact air quality. Improperly used and ventilated backup generators pose health risks that range from nuisance (noise and odor) to life threatening (carbon monoxide poisoning). In addition, weather events with high winds and storm surges such as those many areas in Region 2 have experienced, can generate a tremendous amount of debris from, among other things, destroyed buildings, displaced sand and felled trees. Efforts to remove construction debris (e.g., from buildings) could last months and involve many vehicles which could generate combustion related emissions. Biomass removal could involve incineration which could also operate for months and adversely impact

air quality. Region 2's air program would be required to monitor clean-up efforts to assure compliance with the PM NAAQS.

INDOOR AIR QUALITY

One of the best sources of information on impacts on the indoor environment is *Climate Change, the Indoor Environment, and Health*. The following subsections provide findings from this report from the National Research Council. Indoor environments can be contaminated by chemical, organic, and particulate pollutants that migrate from outdoors. Indoor migration is likely to be of particular concern on high temperature days in residences without air conditioning. Indoor air can also be contaminated by gas stoves and other indoor emission sources, such as building materials, radon, wood stoves, and environmental tobacco smoke. Climate change can affect these factors in various ways. For example, changes in the outdoor concentrations of a pollutant due to alterations in atmospheric chemistry or atmospheric circulation will affect indoor concentrations. The expected increased use of air conditioning, if accompanied by reduced ventilation, could increase the concentrations of pollutants emitted from indoor sources. Additionally, power outages—caused by heat waves or other extreme weather events could lead to the use of portable electricity generators that burn fossil fuels and emit poisonous carbon monoxide (NRC 2011, NC4A 2018).

DAMPNESS, MOISTURE, AND FLOODING

Extreme weather conditions associated with climate change may lead to more frequent breakdowns in building envelopes—the physical barrier between outdoor and indoor spaces—followed by infiltration of water into indoor spaces. Dampness and water intrusion create conditions that encourage the growth of fungi and bacteria and may cause building materials and furnishings to decay or corrode, leading in turn to chemical emissions. Poorly designed or maintained heating, ventilation, and air conditioning systems may introduce moisture and create condensation on indoor surfaces. Humid conditions can, however, be improved by well-designed and properly operating systems (EPA ARC-X, 2021). Mold growth prevention and remediation activities also may introduce fungicides and other agents into the indoor environment (NRC 2011).

PESTS AND INFECTIOUS AGENTS

Weather fluctuations and seasonal to annual climate variability influences the incidence of many infectious diseases which may affect the evolution of existing and emergence of new infectious diseases, for example, by affecting the geographic range of disease vectors. The ecological niches for pests will change in response to climate change, leading to changed patterns or routes of human exposure and potentially, increased use of pesticides in these locations. Climate change may also lead to shifting patterns of indoor exposure to pesticides as occupants and building owners respond to infestations of pests (e.g. termites) whose geographic ranges may have changed. Although decreases in pest populations in some locations may lower the incidence of allergic reactions to particular pests, the overall incidence of allergic disease may not go down, because those individuals with a predisposition to allergies may become sensitized to other regional airborne allergies (NRC, 2011).

BUILDING VENTILATION AND WEATHERIZATION

Leaky buildings are common and cause energy loss, moisture problems, and migration of contaminants from the outdoors (e.g. pests, chemical, volatile organic compounds, and particulates). Research indicates that poor ventilation is associated with occupant health problems and lower productivity in all populations, and is exacerbated in vulnerable populations such as children, seniors, and persons with medical conditions (NRC 2011).

Residents may weatherize buildings to increase comfort and indoor environmental quality in addition to saving energy. Although in general these actions should be encouraged, this may lead to a reduction in ventilation and an increase in indoor environmental pollutants unless measures are taken to preserve or improve indoor air quality. EPA has developed practical guidance for improving or maintaining indoor environmental quality during home energy upgrades or remodeling in single-family homes and schools. EPA's guidance and protocols may need to be revised to include state and local considerations for projected climatic changes. In addition, these programs may need to increase partnerships with other agencies to address training needs and workforce development for building owners, managers, and others, as well as develop new tracking mechanisms to assess the effectiveness of weatherization and remodeling techniques as they relate to indoor environmental quality.

THERMAL STRESS

Extreme heat and cold have several well-documented adverse health effects. High relative humidity exacerbates these effects in hot conditions. As increased frequency of extreme weather events may result in power outages, corresponding increased use of portable generators may expose occupants to potentially dangerous conditions indoors. Seniors, persons with medical conditions, persons of low income, and residents of urban environments are more likely to be exposed to extreme temperature events. These vulnerable populations experience excessive temperatures almost exclusively in indoor environments. Increased temperatures will result in increased use of air conditioning. Air conditioning provides protection from heat but is associated with higher reported prevalence of some ailments, perhaps because of contaminants in HVAC systems (NRC, 2011, NC4A, 2018).

INCREASED ENERGY DEMAND

Increased temperatures due to climate change could have a potential two-fold effect on energy consumption for heating and cooling. Energy used for heating is likely to decrease while energy used for cooling is likely to increase. Summer peak energy demand in the New York metro area could increase 7 to 17%. Increases in peak demand without changes to energy infrastructure could lead to increased brownouts (IPCC 2007, NYSERDA 2011) or operation of "peaker" electric generating units to meet the increased demand. During high energy demand days, peaker units operate and generally produce more emissions than the typical electric generating unit. Furthermore, increased energy use for cooling would occur in the summer, which would lead to increased emissions during the ozone season (unless there is an increase in the supply of renewable energy to match the increased energy demand). The emissions impact from increased energy demand could hinder areas in Region 2 from meeting or maintaining compliance with the NAAQS (PM, O3, NOx). Sources in or upwind of the Region may be required to implement additional control measures or emissions controls. Region 2's air program would oversee states' efforts to develop SIP revisions to address the issue.

MOBILE SOURCE EMISSIONS

Warming due to climate change could lead to damages to transportation infrastructure. Increased frequency, intensity, and/or duration of heat events could lead to railway deformities, road softening, and traffic-related rutting due to the road softening (IPCC 2007). If damages to transportation infrastructure lead to increased congestion, traffic-related emissions could increase. If the costs of maintaining roads and rail lines in good repair divert limited funds from planned mass transit capital projects this could hinder work performed by the Region 2 states and EPA Region 2 in promoting and supporting mass transit projects to reduce transportation related emissions (NYMTC, FTA). Heavy precipitation events resulting from climate change can threaten travel routes on coastal and low-lying roadways, lead to the closure of airports, and damage to shipping channels and ports (IPCC 2007). If these damages and closures lead to traffic congestion in other locations, this could cause increases in mobile source emissions. Extreme events experienced in Region 2, such as hurricanes, that hinder refinery operations or fuel transportation could require EPA to grant fuel waivers to allow more polluting fuels to be used for a short time. Extended periods of congestion could arise in areas that are flooded, which could lead to increased transportation related emissions (USDOT, USDOE).

2. WATER QUALITY

WATERSHEDS, AQUATIC ECOSYSTEMS AND WETLANDS

WATER QUALITY STANDARDS, TMDLs (Total Maximum Daily Loads), and LISTING

Water quality standards established under the Clean Water Act (CWA) are intended to protect public health and welfare; enhance the quality of water; restore and maintain the chemical, physical, and biological integrity of state and territorial waters; and provide water quality protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water. Various impacts of climate change on water quality have been already reported in the literature and detailed in earlier sections of this document. Under section 303(d) of the Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters (i.e., "the 303(d) list"). These are waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes after the implementation of effluent limitations or other pollution control requirements. Climate related stressors are likely to lead to more water quality impairments, which will need to be reflected on 303(d) lists. TMDLs are one tool to help improve the water quality of impaired waters. A TMDL is the calculation of the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet and continue to meet water quality standards for that particular pollutant. Future TMDLs will require modeling to evaluate pollution impacts under a range of projected future climatic shifts.

PERMITTING

More intense precipitation, floods, droughts, increases in ambient water temperatures, and rising sea levels pose challenges for NPDES permittees and permit writers. Managing discharges to protect water quality under these changing conditions can be aided by the refinement of the methods, tools, and information used to develop and implement NPDES permits and programs.

For example, both high and low flows in streams in many parts of the United States are affected by weather, water withdrawals, changes in stormwater runoff due to changes in imperviousness, and other factors. This has highlighted the need for improving methods for calculating critical flow statistics, which are an integral element in developing water quality based effluent limits in NPDES permits. Additionally,

as different parts of the country become drier, wetter or hotter, green infrastructure can be used as a permit tool to help improve community resiliency today and into the future. Green infrastructure filters and absorbs stormwater where it falls. In 2019, Congress enacted the Water Infrastructure Improvement Act, which defines green infrastructure as "the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters." In developing permit requirements, permitting authorities may structure their permits, as well as guidance or criteria for stormwater plans and CSO long-term control plans, to encourage or require permitees to use green infrastructure approaches, where appropriate, in lieu of or in addition to more traditional grey infrastructure controls. Such green infrastructure practices can help communities manage flooding, prepare for drought, reduce urban heat islands, lower building energy demands, spend less energy managing water, and protect coastal areas.

ESTUARIES AND WATERSHEDS

Local and regional partnerships, such as those developed through the National Estuary Program (NEP), identify risks to conserving and managing coastal ecosystems due to a changing climate are sea level rise, warmer waters and atmosphere, increased drought, increased storm frequency and duration, changing surface water hydrology, loss of wetlands, and coastal acidification. These will have significant impacts on freshwater, marine, estuarine, and terrestrial ecosystems. EPA Region 2 continues to support six NEPs to restore and protect critical estuaries and watersheds in the region. They are the Barnegat Bay Partnership, Long Island Sound Study, New York-New Jersey Harbor and Estuary Program, Delaware Estuary Program, Peconic Estuary Partnership, and San Juan Bay Estuary Program.

Increasing temperatures can impact water quality and overall marine and freshwater ecosystems. Warmer waters hold less dissolved oxygen and can have impacts on the species that can survive there. The rising temperatures also appear to be impacting the species that can thrive in these waters with a general shift of species ranges from south to north. Species such as eel grass and the bay scallop appear to be stressed by the higher temperatures and are succumbing to parasites that were previously not an issue for them. Southern species, such as the cow nose ray and black sea bass, which were only occasional visitors to New Jersey and New York, are now appearing in increasing numbers and can consume large amounts of traditionally abundant shellfish (Howell and Auster, 2012; Peconic Estuary Partnership, 2020; Long Island Sound Study, 2021).

Nutrient loading from agricultural lands to watersheds may also be changing due to more intense storms and resulting flooding of cropland, erosion, and runoff. Warming temperatures may also be allowing agricultural and forestry pests that were not common, to now thrive in new areas, thus posing the potential for increased use of pesticides (Deutsch, et. al, 2018).

Harmful algal blooms (HABs) have also become more common in recent years in coastal and inland waters. While the direct cause of the HABs is often elusive, they are frequently associated with warmer stagnant waters and higher nutrient loads, both exacerbated by climate change (Gobler, 2020).

Although long-term signals may be undetectable in estuaries due to their dynamic conditions, coastal acidification is an increasingly pressing issue in the region. Coastal acidification effects are driven by local climate, environmental, and anthropogenic conditions (i.e., temperature, habitat connectivity, nutrient loading and sources, and carbon dioxide (CO_2) inputs from upwelling, atmospheric deposition, freshwater discharge, and various anthropogenic activities) (US EPA, 2021).

WETLANDS

As sea level rises, barrier island configurations will change, and coastal shorelines will retreat. Wetlands will be inundated and eroded, and low-lying areas will be inundated more frequently – some permanently – by the advancing sea. Freshwater wetlands will be subject to changes in hydrology, precipitation and temperatures impacting the ecological services that they provide. Since many coastal areas are already well developed especially in the New York/New Jersey metropolitan region, there is limited opportunity for wetlands to migrate upland. There needs to be a focus on wetland protection, restoration, and capacity for resiliency in all wetland ecosystems. As sea level rises, temperature increases and rainfall patterns change the salinity of estuaries, coastal wetlands, and tidal rivers, which are likely to become more variable, further altering the composition and ecosystem function of existing wetlands. Furthermore, Mid-Atlantic tidal marshes, mangrove forests and other coastal ecosystems in the Caribbean which provide important services for shoreline protection, species habitat, and nutrient cycling in the environment will be vulnerable with sea level rise. Inland wetlands - which provide important services in flood protection, water quality, nutrient cycling, and species habitat - will be vulnerable with changes in precipitation and groundwater recharge. EPA Region 2's wetland and mangrove protection and restoration efforts will face challenges due to uncertainty with regards to sea level rise and the wetland's ability to migrate and respond to changes in hydrology and precipitation.

Changing water flow to lakes and streams, increased evaporation, and changed precipitation in some areas will affect the size of wetlands and lakes. For example, water levels in the Great Lakes are expected to fall. Headwater streams will be increasingly dry during summer months as drought conditions occur more often and evapotranspiration increases. This will influence aquatic ecosystems because species that are susceptible to higher temperatures or lower dissolved oxygen levels, such as freshwater trout fisheries in New York and New Jersey, will lose viable habitat.

COASTAL AND MARINE ECOSYSTEMS

As atmospheric CO_2 increases, more CO_2 is dissolved in the ocean waters. Although the dissolution of CO_2 in oceans is a natural process, the current rate of ocean CO_2 dissolution is unprecedented and has serious implications for the marine food chain and ocean ecosystems. The increase in CO_2 decreases the pH of the water and creates an acidic environment that dissolves the hard shells of corals, shellfish, and smaller organisms. This process, called ocean acidification, also decreases the availability of calcium carbonate ($CaCO_3$), an important building block for shells and the exoskeletons of many marine organisms.

Both the U.S. Fish and Wildlife Service and NOAA report that nearly all endangered animals are sensitive to climate change impacts. Changing climate is reported to impact species directly or indirectly by threats to their habitats. Many economically important species are also at risk, including crustaceans, mollusks, shellfish, fish, and corals, which are especially vulnerable to impacts related to ocean acidification. Although a lot of research is being done on impacts of climate change on corals, there is not much yet known about impacts on various life stages of other culturally and economically important species such as Caribbean spiny lobster (*Panulirus argus),* Atlantic blue crab (*Callinectes sapidus*), or Queen conch (*Lobatus gigas*).

CORAL REEFS

Increasing sea- surface temperatures and ocean acidification have the potential to reduce the stability of corals in Puerto Rico and the Virgin Islands, especially in the presence of stresses from the existing land-based sources of pollution and overuse of the reefs for fishing and recreation. In the Caribbean, already stressed coral reef ecosystems will be highly compromised by the increasing sea surface temperature which will result in more chronic bleaching events and subsequent vulnerability to diseases associated with bleaching. It is well documented in the literature that ocean acidification decreases coral calcification rates and negatively affects their recovery, reproduction, and recruitment (Hoegh-Guldberg et al., 2007).

Ocean acidification will not only reduce the capacity of reef corals to calcify but also will result in decreased ability for corals to protect themselves against more frequent hurricanes (EPA 2012). Damage to coral reef ecosystems will have a significant impact on greater ocean ecosystems, food supplies and recreation and tourism industries. This will make implementation of local stormwater runoff reduction and improved coral reef management efforts by EPA and its partner agencies much more critical for preserving current coral reef habitat.

Coral Reefs provide an important infrastructure for coastal communities, supporting fishery, local jobs and businesses. According to NOAA, coral reefs structures support approximately 4,000 species of fish, 800 species of hard corals and hundreds of other economically valuable species (https://oceanservice.noaa.gov/education/tutorial_corals/coral07_importance.html). Coral reef infrastructure also protects coastal land, providing shorelines with a buffer against 97 percent of the energy from waves, storms, and floods, helping to prevent loss of life, property damage, and erosion. This is important for protection from more frequent and severe hurricanes and storms. Both reef-building hard corals and soft coral species are important components of coral infrastructure (Paoli et al., 2017; Valisano et al., 2016). Both are able to regulate sedimentation and affect water currents, providing a natural barrier protecting coastal communities and land from increased wave action and storms. When coral reefs are damaged or destroyed, this natural barrier becomes absent, making several million people living in U.S. coastal areas adjacent to or near coral reefs more vulnerable to effects of climate change.

DRINKING WATER, WASTEWATER AND STORMWATER INFRASTRUCTURE

QUALITY AND AVAILABILITY OF SAFE DRINKING WATER

Protecting public health from contaminants in drinking water will require adapting to the impacts of climate change. Warmer waters foster pathogen growth, which affects the reliability and the cost of drinking water disinfection. Increased precipitation and more extreme rainfall events will result in additional pollutant loadings from nutrients, pesticides, and other chemicals, further challenging drinking water treatment. Impacts of severe storm events (i.e., heavy flooding, sustained loss of power) could also disrupt a water system's water treatment processes, inhibiting the system's ability to maintain water quality standards and control contaminant levels such as lead and copper.

The New York City Watershed's ability to supply drinking water to 8.5 million people and continue to meet the criteria for the drinking water filtration avoidance, (thereby reducing the need for water supply treatment), may be affected due to increased runoff and turbidity. Small water systems, such as non-PRASA (Puerto Rico Aqueduct and Sewer Authority) systems in Puerto Rico, are particularly vulnerable due to reduced water yields and/or poor water quality. Longer periods of drought are

expected to occur and may produce an increase in the energy needs and costs associated with the production of drinking water.

New drinking water infrastructure, sources and/or enhanced treatment will be needed in some state and tribal localities, including relocating water intakes, and building desalinization plants. Rising sea levels cause intrusion of saltwater into the underground freshwater aquifer, contaminating the supply of usable groundwater and reducing the freshwater supplies for the Caribbean islands, Long Island, and in coastal sections of New Jersey. The consequences of saltwater intrusion vary widely depending on the extent of the intrusion and intended use of the water. In areas such as Cape May, New Jersey, saltwater contamination caused by groundwater extraction has caused the closure of over 100 water supply wells since the 1960s (Lacombe et al. 2002). Saltwater contamination can also increase the need for desalination, an energy-intensive and costly process, to remove salt. Desalination to treat marine or brackish water is becoming increasingly important in certain locations in the Virgin Islands and for circumstances when demand is driven by population growth or drought.

Wastewater or stormwater utilities could distribute reclaimed water from a centralized treatment system for park irrigation or other uses, which may require additional treatment. Aquifer Storage & Recovery (ASR) is a process of storing water underground and then using it to meet future domestic industrial, and agricultural needs. ASR is increasingly used where freshwater demand is beginning to or projected to exceed supply and impact water quantity. While ASR is likely to increase in drought prone areas, when applied to stormwater, this practice can also reduce nonpoint source pollution of our lakes, streams, and rivers. However, the infiltration or injection of polluted stormwater increases the risk of contamination of freshwater aquifers. In Region 2, most ASR facilities are in New Jersey. Considering the increasing demand for water, EPA will need to ensure that groundwater quality and supply are maintained given greater use of this resource (EPA 2012).

GROUNDWATER RECHARGE

Increased temperatures will lead to increased evapotranspiration, thereby reducing the amount of water available to recharge groundwater aquifers (Condon et al., 2020). In the Northeast, the increased precipitation is forecast to occur with heavy downpours while the snowpack will continue to be reduced. These scenarios could result in increased surface runoff with reduced infiltration and groundwater recharge, particularly in upland areas. This would place strains on the use of groundwater for municipal, industrial, and agricultural water supply needs.

Using data from the United States Geological Survey (USGS) Estimated Use of Water in the United States in 2015 and omitting freshwater withdrawal for power generation, we estimate that, in 2015, aquifers supplied groundwater to NJ at a rate of 567 mgd (37% of total freshwater withdrawal), to NY at a rate of 883 mgd (28% of total freshwater withdrawal), to PR at a rate of 118 mgd (18% of total freshwater withdrawal), and to the USVI at a rate of 2.67 mgd (51% of total freshwater withdrawal) (Dieter et al., 2018). Because aquifers supply a substantial portion of freshwater demand in Region 2 and climate change could decrease groundwater recharge, preventing groundwater contamination will become more crucial in maintaining water supplies for the Region.

WATER INFRASTRUCTURE CAPACITY

An increased number of flood events of greater intensity is impacting water infrastructure. Many water and wastewater treatment systems and pumping stations in New York and New Jersey were damaged

due to Hurricane Irene and Superstorm Sandy in 2011 and 2012, and Tropical Storm Ida in 2021. Many of the wastewater facilities were flooded and/or shut down or lost power during these events, after which only primary treatment was performed for a period until the digester systems stabilized and untreated or partially treated sewage was discharged to local waterbodies. Furthermore, providing emergency support to these facilities was complicated by flooding of low-lying access roads, damaged electrical supply systems or shortages of fuel for backup generators, and overstretched personnel. In New Jersey, the Passaic Valley Sewerage Authority facilities alone suffered $300 million in damage due to Superstorm Sandy. This has required major financial resources to pay for the repair or replacement of damaged infrastructure or proactively retrofit existing infrastructure, including treatment plants, pumping stations and conveyance systems. After Tropical Storm Ida, several communities in New Jersey were under boil water advisories due to increased turbidity in drinking water resulting from flooding impacting infrastructure (e.g. water main breaks) and/or source water. An increase in future flood occurrences relative to the 1-in-10 and 1-in-100-year flood events is likely to occur, especially along coastal cities, if increases in storm frequency or intensity continue to take place. Based on the changes in sea level rise alone, it is predicted that the once in a decade coastal flood levels which are currently observed, could soon occur once every one to three years (Rosenzweig et al., 2011).

In June 2013, New York City presented a comprehensive coastal protection plan, which articulates a diverse selection of coastal protection measures tailored to the specific geomorphology of and risks facing neighborhoods most in peril; other local governments will likely develop similar plans as well. Dredged material management plans will need to be adjusted because several of the coastal resiliency projects will use dredged sediments and due to potentially greater sediment loadings entering our waterways and harbors from more intense storm events. While the Army Corps of Engineers is the primary permitting authority on dredged material management in the coastal zone, EPA and the states have oversight roles of dredged materials management activities and are involved in developing dredged materials management plans. Coastal protection measures may also have an impact on water quality in Region 2 coastal waters and in the New York and New Jersey Harbor and Estuary in particular.

General population growth combined with a loss of snowpack in the Northeast and declining surface and groundwater quality and quantity, particularly in the Caribbean, will increase competition for water among the energy and agricultural sectors, public drinking water suppliers, and the overall maintenance of ecological services. This will have an impact on water supply and water use, along with the water body's ability to provide ecosystem services. An example is the stress placed on the cold-water trout fishery due to inadequate reservoir releases in the Pequannock River in New Jersey due to drinking water diversions which causes stream water temperatures to be elevated during the summer months.

Sea level rise in coastal areas threatens fresh water supplies and puts drinking water at increased risk. Saltwater intrusion into coastal aquifers is a problem in areas where withdrawals outpace recharge and the increased pressure head from higher sea-levels worsen this problem. As sea level rises, community drinking water intakes may end up in brackish waters as the salt front migrates up coastal rivers and streams. For example, sodium concentrations could increase at the drinking water intakes on the Delaware River that serve Camden, NJ, degrading the community's supply of drinking water.

The integrity of coastal water infrastructure systems could be put at increased risk because systems designed for current sea levels will likely need to operate under conditions when the sea level is 2 to 5 feet greater than current levels. Wastewater outfalls will have reduced capacity and will have to be redesigned given increased water heights in receiving waters. Communities may need infrastructure

improvements, or to relocate their drinking water and wastewater treatment plants to become more resilient to sea level rise and more frequent storm events.

SEWERS AND WASTEWATER SYSTEMS

Variability in precipitation patterns and an increase in the intensity and severity of storms may lead to an increase in the number of sewer overflows and wastewater bypasses. Predicted increases in storm events and rainfall intensity, as well as sea level rise and storm surges, are estimated to contribute to the frequency and volumes of combined sewer overflow (CSO) discharges in heavily urbanized regions in New York, New Jersey, and Puerto Rico. New York State has 59 CSO permit holders with 816 outfalls, New Jersey has 25 CSO permit holders with 210 outfalls and Puerto Rico has 1 CSO permit holder with 12 outfalls. These include the Region's largest cities, such as New York City, Albany, Binghamton, Rochester, Syracuse, Buffalo, Jersey City, Newark, and San Juan. Furthermore, increased heavy precipitation events could trigger increased sewer overflows and wastewater bypasses, especially in low-lying communities like those surrounding the Martín Peña Canal in San Juan, PR and in the Meadowlands area of NJ. These overflows contain not only stormwater but also pollutants such as untreated human and industrial waste, toxic materials, debris, and oil and grease. Consequences include increased risks of waterborne diseases, greater loads of pollutants entering our waterways, aquatic habitat impairments, loss of recreational access to water bodies due to high bacteria levels, fish kills, fishing and shellfishing restrictions, and increased flows in streams and other conveyance channels that could be eroded. This reduces EPA's ability to achieve our goal to make waterbodies fishable and swimmable.

Utilities face financial challenges when planning for more severe and frequent storm events. Municipalities must evaluate the costs and benefits of alternative approaches for capital infrastructure planning and outlays to address climate impacts. Communities seeking to reduce sewer and wastewater overflows will need to coordinate with the state agencies administering EPA's State Revolving Fund (SRF) programs, which are water infrastructure funds that provide financing options for eligible projects, usually at or below market interest rates. Climate change may lead to greater demand for low-interest infrastructure funding, including from EPA's SRF program.

Increased precipitation may also result in additional pollutant loadings of nutrients, pesticides, and other chemicals, further challenging permittees' ability to meet water quality standards and permit requirements. For industrial dischargers and wastewater treatment plants, lower baseflows due to increased evapotranspiration and increased likelihood of drought conditions will make meeting permit requirements more challenging. This will have an impact on our watershed programs as well as our regulatory programs, including the National Pollutant Discharge Elimination System (NPDES) and TMDL programs.

SEPTIC SYSTEMS

Just as centralized wastewater systems are impacted by climate change, decentralized wastewater systems (septic systems or onsite wastewater treatment systems) face similar, however more localized, challenges. The basic components of a septic system include a septic tank to receive, collect, store, and treat solids and a soil drainfield to treat liquid effluent. Drainfield treatment effectiveness and efficiency is dependent on soil type and characteristics. When septic systems are properly planned, designed, sited, installed, operated, and maintained they can provide excellent wastewater treatment. However, a system's performance depends on having aerobic, and then anaerobic soil conditions in the drainfield

for nitrifiers and denitrifying bacteria to properly treat nutrients and nitrogen in wastewater effluent. When overland flooding occurs, or when soils are saturated for extended periods of time, septic tanks can overflow and drainfields will not function properly. With increased variability and intensity of precipitation events that saturate soils, flooding events can inundate these systems and cause sewage to back up into homes and/or release to the environment and expose property owners and others to untreated sewage. The sewage release contains pathogens and nutrients which can also enter surface and groundwater, thereby negatively impacting drinking water supplies, public health, water quality and recreation. Septic systems located in low lying areas, near the coast, or in poorly drained soils are most vulnerable to climate change induced failure.

In Region 2, the major contaminants that could increase due to climate change induced septic system failures are human pathogens, nutrients, and other household sewage related contaminants. Pathogen contamination is a human health risk and nutrient contamination (both nitrogen and phosphorous) will fuel greater marine and freshwater algal blooms, some of which may be Harmful Algal Blooms (HABs). Failures or substandard systems also lead to higher nitrate concentrations in groundwater and surface waters. Certain areas such as Suffolk County, NY, The Shinnecock Indian Nation, and areas of Puerto Rico and the U.S. Virgin Islands are particularly threatened as they are coastal communities that still rely on numerous substandard cesspools for wastewater management. These antiquated systems lack adequate treatment via a horizonal drain or distribution field and are prone to backups and/or overflows with high rainfall events. EPA works with local officials and partner organizations to support onsite wastewater management, provide public education and outreach, and develop and implement voluntary guidelines, policies and technical guidance for onsite wastewater management. EPA also provides technical assistance and technology development to support more effective use of Innovative / Advanced (I/A) septic system technologies particularly in coastal marine areas.

3. CONTAMINATED SITES

RISK OF CONTAMINANT RELEASES

The prospect of more intense and more frequent storms and sea-level rise carries with it the risk of contaminant releases from RCRA Corrective Action sites, Superfund sites, Brownfield sites and landfills. As noted in EPA's Climate Change Adaptation Plan, inundation and flooding may lead to transport of contaminants through surface soils, sediments, groundwater, surface waters and/or coastal waters. Uncontrolled migration of contaminants may pose an increased risk of adverse health and environmental impacts. An example in Region 2 is American Cyanamid, a Superfund site on the banks of the Raritan River in Bridgewater Township, NJ. The site has two impoundments of harmful chemicals that released contamination during major flood events caused by Hurricanes Floyd and Irene (1999 and 2011 respectively). Since then, a remedy was selected to excavate waste within the impoundments, solidify/stabilize materials impacted by the waste, and place a protective cover over the entire area. However, September 2021's Tropical Depression Ida caused a 500-year flood event and even though most of flood resiliency infrastructure improvements remained operational, the impoundments were overtopped by floodwater and an estimated 300+ million gallons of floodwaters had to be released into a brook in a controlled manner. Thus, moving forward, the containment berms around the impoundments will need to be raised to protect against future 500-year flood events.

While contaminant release and dispersal is most relevant to sites that have not yet been remediated, sites with certain types of remedies may also be vulnerable. For example, a rise in groundwater levels could lead to a failure in a groundwater containment system.

Other climate considerations include saltwater intrusion and increased groundwater salinity in coastal aquifers that may increase the permeability of clay liners installed at waste sites, such as landfills, allowing contaminants to spread to nearby properties. Several landfills in Puerto Rico and the USVI are located at or near sea level. Many of these landfills are still operating and/or have been improperly closed. Rising sea level poses a significant risk of erosion to these landfills and the potential migration of contaminants towards nearby communities and ecosystems (i.e., coastal wetlands and coral reefs). Examples of these are the Culebra Island Landfill and the Rincon Municipal Landfill.

Severe storms, storm surge and sea level rise may also cause flooding of coastal or other riparian located facilities in Region 2 where chemicals, oil or other hazardous substances are present. Of notable concern are pesticide and chemical production or storage facilities, which are governed by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Toxics Substances Control Act (TSCA), respectively. These facilities are also vulnerable to extreme weather events, possibly leading to the dispersal of such materials to nearby properties or surface waters and, in turn, creating risks to public health and the environment. This is an issue raised by local environmental justice groups to EPA, since several such facilities in the Region are located near low-income minority communities. Releases of hazardous substances or other materials from such facilities could potentially lead to cleanup actions by EPA's Superfund program, the oil spill response program, or state or local government response programs. Large storms can also impact Superfund sites during construction resulting in possible exposed or redistributed contamination.

Power outages impact groundwater pump and treat facilities at Superfund sites during storm events such as Superstorm Sandy. At the Ciba Geigy Superfund Site, the owner, BASF leased 166 acres of the site for a 35-megawatt grid-tied ballasted, solar array system within the footprint of the former manufacturing area and connects to an on-site substation. A smaller 2-megawatt net-metered solar array provides nearly 100% of the electricity to power the site's groundwater extraction and treatment system, thereby allowing the system to remain powered during outages.

ADVERSE EFFECTS ON CLEANUPS AND EMERGENCY RESPONSE

As noted in the Agency-wide Climate Change Adaptation Plan, changes in precipitation patterns and temperature as a result of climate change may adversely affect the performance of some site cleanup remedies and may require some remedies to be changed. In August 2018, EPA's Office of Land and Emergency Management (OLEM) released a report, Evaluation of Remedy Resilience at Superfund NPL (National Priority List) and SAA (Superfund Alternative Approach) Sites, which identified vulnerabilities and resiliency measures based on sites impacted by Hurricanes Harvey, Irma and Maria. This report built upon earlier efforts to understand how resiliency measures are considered in conceptual site models, remedy system designs and operations, and how resilience is built into remedies at Superfund sites. The assessment identified sites with remedies that EPA considers to be the most vulnerable to the direct effects of a hurricane. The data gathered, although not comprehensive, provides some general observations, as well as some insight, regarding the design measures that can help remedies remain protective during extreme wind and flooding, including automated shut-off controls to prevent tank overflow; the use of berms, dikes and other erosion control; and hazard preparedness plans such as moving drums to enclosed structures. The analysis completed for this study concludes that resiliency measures are being implemented at Superfund NPL and SAA sites where remedies are in place. The report pointed out the vulnerability of relying on the power grid, including sites in Puerto Rico and the U.S. Virgin Islands which experienced sustained power outages and the extensive damage to roads,

powerlines, and other infrastructure which made restoring power or providing alternative power challenging. Research into solar power and other alternative power sources may help alleviate sustained shutdown of operating remedial systems, such as groundwater pump and treat systems.

4. CHEMICAL SAFETY AND POLLUTION PREVENTION

USE OF TOXIC CHEMICALS

A changing climate will likely result in changes in the kind of agricultural crops planted in New York, New Jersey, and the Caribbean. For example, current cash crops in the Northeast such as apples, maple syrup, and cranberries will likely move further north into Canada while crops now grown in the Southeast will move into the region (USGCRP 2009). This in turn will affect the quantity, type, and timing of agricultural chemical use as well as the appropriate application method. These changes in chemical use and application could impact the appropriate risk management decisions made by EPA Region 2's Pesticides Program in determining what pesticides and geographic areas to focus our efforts to ensure compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), particularly with regard to the protection of migrant farm workers and rural communities. For instance, soil fumigation as a method to apply pesticides is now rarely used in Region 2 but would be expected to become more common as crops move into the area that requires pest techniques that are associated with longer growing seasons and warmer winters (NYSERDA 2011). Soil fumigants are among the most hazardous of all pesticides and rapidly volatilize once in the soil. Once in gaseous form, the fumigant can disperse throughout the soil and contact target pests making them extremely effective. However, because of the volatility of fumigants, people who live, visit, and/or work near fumigated fields may be exposed to these toxic emissions if the gases travel offsite either via wind aboveground or through wells, sewers, vaults and other underground pathways to the surface. Consequently, EPA Region 2's Pesticides Program would likely need to reevaluate its priorities if spray drift from fumigants becomes more common in Region 2.

Similarly, changes in temperature and precipitation levels are expected to result in increased cases of the West Nile Virus and other diseases carried by mosquitoes, some not usually found this far north. In fact, the migration of Aedes albopictus (Asian tiger mosquito) has resulted in increasing populations in more northern regions, especially Region 2 (Shoppe 1991). These mosquitoes have begun to take over areas previously inhabited by the Culex *species* of mosquito *during* the winter (i.e., NYC). The movement of this invasive species may increase the northward spread of Dengue. As the incidence and type of diseases carried by mosquitoes increases, EPA Region 2's Pesticides Program will likely need to broaden their knowledge of new types of pesticides and/or application methods to ensure compliance with FIFRA. EPA will also need to engage diverse stakeholders with disparate views on the merits of spraying pesticides. These activities will have resource implications for EPA Region 2 as will most of the programmatic impacts referenced in this Assessment.

EXPOSURE TO TOXIC CHEMICALS FROM INFRASTRUCTURE DAMAGE

The extreme weather events that are likely to occur as a result of climate change (e.g., high winds, heavy precipitation events) may damage community infrastructure (e.g., schools and childcare facilities) and residential homes. As a result, there may be an increased risk of exposure to lead, asbestos and PCBs, when these buildings are initially damaged and when they are renovated/demolished as part of the recovery efforts. Children are particularly vulnerable to this risk, particularly those living in disadvantaged communities where buildings tend to be older and poorly maintained. Therefore, to mitigate/prevent such exposure and ensure compliance with the Toxic Substances Control Act (TSCA), EPA Region 2's Toxics Substances program will need to educate the affected communities about safeguarding themselves and provide technical assistance to debris removal companies and the

construction/renovation industry. Depending on the extent of the communities impacted and the amount of damage resulting from these extreme weather events, the capacity of EPA Region 2 Toxic Substance program to provide such information/assistance in a timely manner, especially in a face-to face format, could be sorely tested.

5.FACILITIES AND OPERATIONS

EPA Region 2's main office is in Lower Manhattan, with other facilities in Edison, NJ, and Guaynabo, PR, as well as small field offices in Hudson Falls and Buffalo, NY, Stamford, CT and in the U.S. Virgin Islands. Our Edison, NJ facility houses, among other things, our regional laboratory, and EPA's Emergency Response Team. Overall, Region 2 currently has about 840 employees. The climate change impacts discussed in the above sections present a number of risks to Region 2's staff, facilities, assets, and day-to-day operations, as summarized below.

FACILITY OPERATIONS, SAFETY AND EMERGENCY COMMUNICATIONS

Extreme heat, poor air quality or other weather conditions exacerbated by climate change may increase the health risks of EPA Region 2 employees and contractors engaged in field work (such as sampling, remediation and inspections). This may force them to either delay such work or forgo it completely. In addition, increased demands placed on electrical grids during heat waves could jeopardize the grids' integrity or force utility providers to institute rolling brownouts or blackouts. The occurrence of such outages would force EPA to use auxiliary power sources (generators, uninterrupted power supplies). Building lighting, HVAC systems and/or elevator service may have to be reduced or adjusted to compensate for the loss of power. EPA offices could potentially close for short periods of time due to impacts of hurricane, tropical storms or other weather events and potential impacts on the facilities themselves and the employees' ability to safely travel to and from work. In addition, potential water shortages due to reduced water availability as a result of prolonged drought could disrupt day to day operations. Severe storms (for example, as seen during Superstorm Sandy) could also cripple public transportation systems, highways, and roads, and/or result in significant gasoline shortages, thus preventing Region 2 employees from being able to come into work. Many of these scenarios are already addressed as a result of the implementation of EPA's COVID-19 Protocol, as EPA has prepared and continues to prepare for such scenarios through our telework program, portable computing equipment for employees, remote networking capabilities, and development of e-recordkeeping, e-reporting and e-workflow systems, but at a minimum, some impact on productivity can be expected. In addition, many regional staff conduct field-based work, such as site remediation, sampling, and inspections and instability of weather patterns (with more heavy snow and ice events in winter months in Northeast; more severe tropical storms in the Caribbean) impacts the safety of such staff traveling to and from remote (and sometimes off-road) locations and increases the chance for automobile accidents with government vehicles. Although it is true that over the course of EPA's response to the COVID-19 pandemic, we have been able to adjust some of our field-based work to accomplish some portion remotely (i.e., off-site compliance record reviews, MS teams closing/opening meetings), not all field-based work could be so handled and thus, an impact on the effectiveness of EPA Region 2's field activities will likely occur as a result of climate change.

EPA Region 2 has Continuity of Operations Plans that are formulated to address an "all hazards" approach. Damages to EPA facilities and/or impacts to critical infrastructure due to extreme weather events could force Region 2 to implement those plans, or even Devolution of Operations Plans, for EPA to continue to execute Mission Essential Functions. The Region maintains a Continuity of Operations site in Edison, NJ that can provide fully supported workspace for up to 200 emergency support personnel. The site has backup power and was constructed to withstand hurricane force winds and earthquake level forces.

Over time, climate change may result in EPA Region 2 personnel, including those working in our emergency response program or who collect and/or analyze environmental samples (and our contract support staff, public affairs staff, and others) being increasingly drawn way from their normal day-to-day activities to respond to extreme weather events or emergencies. This, in turn, could lead to a reduced capacity to perform regular duties (e.g., monitoring compliance with and enforcing hazardous waste laws).

IMPACTS ON WATER SUPPLIES USED BY EPA REGION 2

As described previously, water availability, quality, and safety could be compromised by climate influenced events. At all regional offices and the laboratory, the staff relies upon potable drinking water from municipalities. The availability of safe drinking water (as described in the Superstorm Sandy example) needs to be considered for all offices. Water supply issues could impact the Regional Lab at Edison, NJ, and its ability to operate. In Edison, the ORD National Risk Management Research Laboratory conducts research on stormwater management practices and technologies. In-situ research requires copious amounts of water to mimic various storm intensities (and related overflows). Droughts can impact the Laboratory staff's ability to test technologies and conduct research because access to water could be limited through rationing/availability.

EPA developed a Water Conservation Strategy that identifies water conservation projects and approaches that reduce potable water use by 2% annually. This strategy applies to EPA-owned spaces, such as the Edison, NJ facility and laboratory that are owned and operated by the Region 2. Projects to ameliorate local water supply issues include gray water (rainwater runoff and water condensation) capture for cooling. Increased drought intensity – and overall changes with the frequency and intensity of storm events – may reduce the availability of gray water over time.

In addition, water shortages could impact office operations of leased space in Puerto Rico, U.S. Virgin Islands, New York, and New Jersey. Spaces leased from the U.S. General Services Administration (GSA) may be dependent upon water for consumption, cooling, landscaping, etc. However, GSA (directly or indirectly) is the responsible party for addressing water conservation and stormwater reduction. During extreme drought conditions, employees may be asked to conserve water such as limit watering plants, showering at the facility gym, etc. Long-term droughts and increased scarcity of water may cause local water rates to increase thereby increasing operational costs related to potable water use in office buildings and negotiated during lease renewal.

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4. Priority Actions

This section presents a list of priorities that represent regional actions to reduce the impacts of climate change on EPA Region 2 programs and authorities. Region 2's 36 priority actions are categorized into six thematic areas: (1) Advance Research, Systems and Guidance that Support Climate Adaptation in Region 2; (2) Leverage Partnerships & Conduct Outreach to Enhance Adaptative Capacity in Region 2; (3) Seek Opportunities to Integrate Environmental Justice into Each of Our Climate Change Priority Actions, to the Extent Practicable; (4) Support the Use of Disaster Recovery Resources and Mitigation Strategies to Assist States, Local Communities, Indian Nations, and Territories in their Adaptation Efforts; (5) Use our Authorities to Innovate and Expand our Work on Climate Adaptation; and (6) Maintaining Region 2 Facilities and Operations.

In alignment with EPA's October 2021 *EPA Climate Adaptation Action Plan* and Administrator Regan's 2021 *Policy Statement on Climate Change Adaptation,* each listed priority includes the following information: (1) a description of the action; (2) a brief explanation of how the Region will measure progress on the action; (3) the vulnerabilities addressed by the action; (4) any co-benefits associated with the action (such as mitigation of greenhouse gases and other pollution, public heath, economic growth and job creation, national security, and environmental justice); (5) whether sufficient resources currently exist to implement the priority action or additional resources will be required; and (6) linkages to EPA's draft strategic plan and the priorities in EPA's October 2021 national Climate Adaptation Action Plan.

The climate adaptation priorities in the 2021 EPA Climate Adaptation Action Plan, which are referred to by number in each action, below, are as follows:

Climate Adaptation Priorities

1. Integrate climate adaptation into EPA programs, policies, rulemaking processes, and enforcement activities.
2. Consult and partner with states, tribes, territories, local governments, environmental justice organizations, community groups, businesses, and other federal agencies to strengthen adaptive capacity and increase the resilience of the nation, with a particular focus on advancing environmental justice.
3. Implement measures to protect the agency's workforce, facilities, critical infrastructure, supply chains, and procurement processes from the risks posed by climate change.
4. Measure and evaluate performance.
5. Identify and address climate adaptation science needs.

Region 2 recognizes the iterative nature of adaptation planning and will use an adaptive management framework, in conjunction with EPA Headquarters' timing of future Adaptation Plan updates, to revisit, adjust, amplify and narrow these priority actions. An adaptive management framework will assist the Region to address evolving information and uncertainties about Regional climate change impacts,

effectiveness and feasibility of our priority actions, and changing resources and needs. We therefore view this Plan as a living document that the Region will periodically revisit.

All the priority actions included below are for both FY '22 and FY '23 unless otherwise noted. Although some work on these priority actions can begin, and have begun in FY '22, many of the actions depend on receiving additional resources. Therefore, in those circumstances where Region 2 can start an action or do some portion of the action but is unable to complete the action without additional resources, we have indicated "use existing and additional resources." In addition, some of the actions are dependent on in-person events, for example at schools, and are therefore subject to change based on changing COVID restrictions.

Theme 1: Advance Research, Systems and Guidance that Support Climate Adaptation

Region 2 has identified the following 8 priority actions under this theme:

- Update the Climate change portion of Region 2's Five-Year Review Guidance to provide additional guidance to Remedial Project Managers (RPMs) on screening sites for climate vulnerabilities, update Green Remediation metrics and expanding collection of data, and develop tools RPMs can use to evaluate Climate Risks, such as remedy database and best practices. (SEMD)
    - Measure/Metric/Target: Train staff on updated Five-Year Review Guidance and tools. Goal is 2-3 trainings per year with additional trainings for new RPMs if necessary.
    - Vulnerability Addressed: Changes in precipitation patterns and temperature as a result of climate change may adversely affect the performance and permanence of some site cleanup remedies and may require some remedies to be changed.
    - Strategic Plan Linkage: 6
    - Adaptation Plan Linkage: Priority 2
    - Co-Benefits: Protection of public health and the environment by making Superfund remedies more resilient.
    - Resources: Requires current and additional resources

- Conduct a vulnerability assessment of existing remedies using various screening tools available and prioritize those that need further evaluation. (SEMD)
    - Measure/Metric/Target: In FY '22, through section and/or branch meetings, promote conducting vulnerability assessments for each site in Region 2.
    - Vulnerability Addressed: Changes in precipitation patterns and temperature as a result of climate change may adversely affect the performance of some site cleanup remedies and may require some remedies to be changed.
    - Strategic Plan Linkage: 6
    - Adaptation Plan Linkage: Priority 1 and 4
    - Co-Benefits: Protection of public health and the environment by making Superfund remedies more resilient.
    - Resources: Uses current resources

- Develop and implement changes to regional compliance monitoring and enforcement processes to strengthen the Region's adaptive capacity and resiliency such as e-workflows, e-reporting, and electronic recordkeeping. (ECAD)
    - Measure/Metric/Target: In FY '22, work with IRMB to modernize our Sharepoint Field Activity Sites to add recordkeeping schedules and improve efficiency of existing e-workflows. In FY '23, begin implementation of such sites across regional enforcement programs for new compliance assurance and enforcement work and ensure historical data has all the correct recordkeeping information.
    - Vulnerability Addressed: Facility Operations, Safety and Emergency Communications
    - Strategic Plan Linkage: Strategic Plan Goal 3
    - Adaptation Plan Linkage: Priority 1 and 4
    - Co-Benefits: Government-wide priority to go paperless; More efficient records management; Enable Workplace Flexibilities; Improve timeliness of compliance monitoring and enforcement processes.
    - Resources: Requires additional resources

- Determine the impacts of increased residential electrification (non-gas homes), vehicle electrification, and cryptocurrency on electrical grid resilience in the face of extreme heat events, and on increased climate-related ozone formation (ARD)
    - Measure/Metric/Target: Quantification of impacts of electrification. In FY '22 ARD will scope and develop an EPA Research Proposal on determining the impacts of electrification in R2. In FY' 23, if the proposal is selected, R2 will began modeling and quantification of electrification.
    - Vulnerability Addressed:
    - Strategic Plan Linkage: 5
    - Adaptation Plan Linkage: Priority 1 and 4
    - Co-Benefits: If the impacts of residential and vehicle electrification demonstrate a reduction in emissions in the Region the information can be used to increase support for these efforts and demonstrate the need to develop zero carbon emissions energy generation. The impact of cryptocurrency could shape how the Region looks these activities as sources that electrical suppliers need to account for in determining generation needs. This action will also provide information on particulate matter emissions. There are vulnerable communities impacted ozone nonattainment issues.
    - Resources: Need additional resources

- Modeling and demonstration of the increased impacts of increased cooling degree days (CDD) and High Electric Demand Day (HEDD) emissions by out of region sources to quantify and demonstrate the impacts on the NY metro area O3 nonattainment area. (ARD)
    - Measure/Metric/Target: Meeting the NAAQS for O3 (Ozone). In FY '22 ARD will scope and develop an EPA Research Proposal on modeling the impacts of CCD and HEDD emissions on ozone concentrations in the NY metro area. In FY 23, if the proposal is selected R2 will begin working on the action.
    - Vulnerability Addressed:
    - Strategic Plan Linkage:
    - Adaptation Plan Linkage: Priority 1
    - Co-Benefits: Information from this action can be used to assist energy suppliers on how to plan for meeting future demand. Vulnerable communities are impacted by

the increased CDD with respect to both air quality impacts and economic impacts due to increased energy use.
    - Resources: Need additional resources

- Monitor/review the identified biannual Regional Science Needs and research proposals to ensure climate adaptation needs are recognized, where applicable (LSASD)
    - Measure/Metric/Target:
    - Vulnerability Addressed:
    - Strategic Plan Linkage:
    - Adaptation Plan Linkage: Priority 2 and 5
    - Co-Benefits:
    - Resources: Needs additional resources

- Finalize the EPA/FEMA, NYS DOS RISE Tool and expand the number of communities the Region is supporting in the TA Workshops provided and in the number of communities we are able to support in follow-up steps (SPO)
    - Measure/Metric/Target: In FY '22, RISE Tool will be finalized and Region 2 will seek Hurricane Ida funding to support implementation of the RISE tool in at least one community during FY '23; In FY '23, Region 2 will implement the RISE tool in the Ida-funded community.
    - Vulnerability Addressed: Communities vulnerable to disasters and extreme storm events.
    - Strategic Plan Linkage: Goal 6
    - Adaptation Plan Linkage: Priority 1 and 2
    - Co-Benefits: Environmental Justice
    - Resources: Uses current resources

- Identify opportunities to evaluate site locations and incorporate green cleanup techniques and more resilient cleanup approaches as part of the long-term stewardship of RCRA corrective action and PCB cleanup approvals. (LCRD)
    - Measure/Metric/Target: Measure = Increase outreach and education around green cleanup techniques; Metric = # of sites utilizing green cleanup techniques for corrective action and PCB
    - Vulnerability Addressed: RCRA corrective actions located in floodplains, areas subject to sea level rise, or other areas that could be affected by threats from climate change.
    - Strategic Plan Linkage: Objective 6.1
    - Adaptation Plan Linkage: Priority 1
    - Co-Benefits: Public health and environmental justice
    - Resources: Uses current resources

Theme 2: Leverage Partnerships & Conduct Outreach to Enhance Adaptative Capacity

Region 2 has identified the following 12 priority actions under this theme:

- Organize and promote wide participation at the proposed *3rd Climate Change in the Caribbean Conference: Promoting Climate Resilience in the U.S. Virgin Islands and Puerto Rico*. This conference is an educational tool that, in addition to climate adaptation and mitigation, will include discussions related to Indigenous Engagement, Climate Justice including Equity and Environmental Justice, and will promote more collaboration among the federal and the U.S. Caribbean territorial governments (PR and USVI), community organizations, academia, philanthropy entities, among others. (CEPD and ORC)
    - Measure/Metric/Target: Hold one of two conferences in FY '22 (second conference centered on Pacific U.S. Insular Areas and Hawai'i); In FY '23, develop workplan for U.S. Pacific and Caribbean Islands based on outcome of the conferences for 2022-2024
    - Vulnerability Addressed: All vulnerabilities
    - Strategic Plan Linkage:
    - Adaptation Plan Linkage: Priority 2
    - Co-Benefits: Public health and environmental justice
    - Resources: Use existing and additional resources

- Partner with state and federal agencies to include climate resiliency and climate justice considerations in all Bipartisan Infrastructure Law-related projects such as water infrastructure, National Solid Waste for Recycling Infrastructure Grants, Brownfields, Pollution Prevention and Source Reduction Assistance Grants. (WD and LCRD)
    - Measure/Metric/Target:
    - Vulnerability Addressed: Sewers and wastewater systems; drinking water quantity and quality; recreational water quality; water infrastructure
    - Strategic Plan Linkage: Goal 5, Obj 5.1, 5.2; Goal 2, Obj 2.1, 2.2
    - Adaptation Plan Linkage: Priority 2
    - Co-Benefits: Environmental justice
    - Resources: Use current and additional resources

- Increase water-related climate literacy and information exchange, this includes the development of workshops and presentations where the WD highlights climate change as a significant component (WD)
    - Measure/Metric/Target: WD will hold two planning sessions to offer workshops and/or speakers to communities and/or schools with environmental justice concerns in fiscal year '22 and beyond. fiscal .
    - Vulnerability Addressed: All water-related vulnerabilities
    - Strategic Plan Linkage: Goal 5, Obj 5.1, 5.2
    - Adaptation Plan Linkage: Priority 2
    - Co-Benefits: environmental justice
    - Resources: Uses current and additional resources

- Incorporate climate change language into new releases and social media content, as appropriate, and plan and execute public events and elected official briefings that support Region 2 Climate change related programs and activities. Distribute existing climate change literature and tools the public can take and/or use (PAO)
    - Measure/Metric/Target: # New releases; # of posts
    - Vulnerability Addressed:
    - Strategic Plan Linkage:

- Adaptation Plan Linkage: Priority 1 and 2
- Co-Benefits: Environmental Justice
- Resources:

- Advance adaptation in Region 2 through the Mid-Atlantic Federal Climate Partners (CCWG)
    - Measure/Metric/Target: Raise opportunities for cross-Agency collaboration on adaptation during at least 4 MAFCP meetings in FY '22 and identify at least one project for FY '23.
    - Vulnerability Addressed: Any of the vulnerabilities could potentially be addressed through cross-Agency collaboration
    - Strategic Plan Linkage:
    - Adaptation Plan Linkage: Priority 2
    - Co-Benefits: Environmental justice
    - Resources: Use existing and additional

- Partner with Indian Nations, through collaboration and consultation, on their current and future resiliency efforts. (SPO)
    - Measure/Metric/Target: Have at least 5 engagements a year to collaborate with Nations.
    - Vulnerability Addressed: A number of different specific vulnerabilities of Indian Nations.
    - Strategic Plan Linkage: Objective 1.3, 2.1, Objective 6.3
    - Adaptation Plan Linkage: Priority 2
    - Co-Benefits: Environmental Justice, Disaster Mitigation
    - Resources: Requires current and additional resources

- Partner with Indian Nations to identify techniques for addressing invasive species impacting biodiversity and crop harvesting. (SPO)

    - Measure/Metric/Target: Hold meetings with the Nations within Region 2 and Region 2's programs to develop a strategy and identify resources for next steps. Develop a draft resource list and strategy in FY '22 and finalize the resource list and strategy in FY '23.
    - Vulnerability Addressed: This action will address agriculture-related and trauma-related vulnerabilities
    - Strategic Plan Linkage: Objective 5.2
    - Adaptation Plan Linkage: Priority
    - Co-Benefits: Water Quality, Environmental Justice
    - Resources: Requires additional resources

- Partner with Indian Nations to identify shoreline stabilization techniques. (SPO)
    - Measure/Metric/Target: Meet with Nations within Region 2 and Region 2 programs to develop a strategy and identify resources for next steps. Develop the draft resource list and strategy in FY '22 and finalize the resource list and strategy in FY '23.
    - Vulnerability Addressed: Water-related vulnerabilities
    - Strategic Plan Linkage: Objective 2.1, Objective 5.2, Objective 6.3
    - Adaptation Plan Linkage: Priority 2

  - Co-Benefits: Water Quality, Environmental Justice
  - Resources: Requires additional resources

- Promote Integrated Pest Management Practices (IPM) and Compliance Assistance to Schools in EJ Areas by collaborating with them through IPM assessments. (LCRD)
  - Measure/Metric/Target: Measure = Number of IPM assessments conducted; Metric = Number of schools receiving outreach and education on IPM and Pesticide Safety. Target for FY '22 is 5-10 private schools and 3 public schools, in 3 environmental justice areas.
  - Vulnerability Addressed: Changes in temperature and precipitation levels are expected to result in increased cases of the West Nile Virus and other diseases carried by mosquitoes and pests.
  - Strategic Plan Linkage: Objective 7.1
  - Adaptation Plan Linkage:
  - Co-Benefits: Environmental Justice
  - Resources: Uses current and additional resources

- Expand the monthly "Resource Newsletter" that currently focuses on community development to include adaptation and recovery resources to the extent possible. We will also work to expand the audience to ensure communities most at risk to disaster impacts are able to access the newsletter. (SPO)

  - Measure/Metric/Target: Include adaptation/recovery resources in 75% of editions.
  - Vulnerability Addressed: Several vulnerabilities related to extreme weather
  - Strategic Plan Linkage: Goal 2, Objective 6.3
  - Adaptation Plan Linkage: Priority 1 and 2
  - Co-Benefits: Environmental justice, Disaster mitigation
  - Resources: Uses current resources

- Region 2 will leverage its partnerships with ORD and other agencies and institutions to address the mental health impacts of climate change using our respective programs and authorities. (SPO)
  - Measure/Metric/Target: In FY '22, Region 2 will have an initial meeting with ORD and at least two other partners to explore opportunities for collaboration on climate change-related mental health. Region 2 will also pilot the use of ORD's ERB tool during FY '22 in one R2 community and meet at least once with HUD, HHS and FEMA to identify how to support communities experiencing trauma after disasters using our base programs and resources. In FY '23, Region 2 will highlight the results from the ERB pilot and explore expansion to other communities.
  - Vulnerability Addressed: Mental health and trauma-related effects from climate hazards
  - Strategic Plan Linkage:
  - Adaptation Plan Linkage: Priority
  - Co-Benefits:
  - Resources: Uses current and additional resources

- Advance the use of Environmental Collaboration and Conflict Resolution (ECCR) within Region 2 and/or with our partners and stakeholders to support collaborative processes on climate change adaptation. (ORC)
    - Measure/Metric/Target: In FY '22, promote the use of ECCR for climate change adaptation, highlighting the linkage with environmental justice, at three events available to Region 2 staff and/or our partners and stakeholders.
    - Vulnerability Addressed: This action addresses the challenges experienced during collaborative efforts and potential conflicts related to climate change
    - Strategic Plan Linkage: Goal 4; Cross-Agency Strategy 4
    - Adaptation Plan Linkage: Priority 1 and 2
    - Co-Benefits: Improved relationships with Region 2 partners and stakeholders
    - Resources: Current resources

Theme 3: Seek Opportunities to Integrate Environmental Justice into Each of Our Climate Change Priority Actions, to the Extent Practicable

Region 2 has identified the following 3 priority actions under this theme:

- Region 2 will integrate environmental justice into our adaptation work and, in part, accomplish this priority through coordination of the Region 2 Climate Change Workgroup and Region 2 Environmental Justice Workgroup. (**ALL DIVISIONS**)
    - Measure/Metric/Target: In FY 22, five of the nine WD sections will propose ideas to better integrate climate change and EJ into the work they perform. In FY 23, the remaining four of the nine WD sections will propose ideas to better integrate climate change and EJ into the work they perform.
    - Vulnerability Addressed: All vulnerabilities
    - Strategic Plan Linkage: Goal 2 Obj. 2.1, 2.2
    - Adaptation Plan Linkage: Priority 2
    - Co-Benefits: Environmental Justice
    - Resources: Requires additional resources

- Showcase in Region 2 Water Division's annual report our grantees' and partners' efforts to implement climate change adaptation activities, especially in vulnerable populations. (WD).
    - Measure/Metric/Target: In FY '22 and FY '23, WD will include five climate change-related highlights in our annual highlights report.
    - Vulnerability Addressed: n/a
    - Strategic Plan Linkage: n/a
    - Adaptation Plan Linkage: Priority 2 and 3
    - Co-Benefits:
    - Resources: Uses current and additional resources

- Continue to integrate the concept of climate justice into our programs and activities. (WD)
    - Measure/Metric/Target: In FY '22 and FY '23, WD will integrate the concept of climate justice into five (5) of our speeches or talking points for internal or external engagements.
    - Vulnerability Addressed: All water-related vulnerabilities

- Strategic Plan Linkage: Goal 2 Obj. 2.1, 2.2
- Adaptation Plan Linkage: Priority 2
- Co-Benefits: Environmental Justice
- Resources: Uses current and additional resources

Theme 4: Support the Use of Disaster Recovery Resources and Mitigation Strategies to Assist States, Local Communities, Indian Nations, and Territories in their Adaptation Efforts

Region 2 has identified the following 5 priority actions under this theme:

- Work with our inter-agency partners to identify how disaster funding could be used to support state and local mitigation activities. (All Divisions [SPO Coordinating])
  - Measure/Metric/Target: In FY '22, participate in at least 5 interagency meetings and the National Mitigation Investment Strategy (NMIS) Demonstrate Workgroup to begin to identify BMPs and case studies
  - Vulnerability Addressed: All
  - Strategic Plan Linkage:
  - Adaptation Plan Linkage: Priority
  - Co-Benefits:
  - Resources: Uses current and additional resources

- Integrate climate change adaptation in disaster recovery by supporting energy resiliency efforts and natural based solutions in watershed management, storm water and flood control, coastal erosion, and flooding in the Caribbean and other impacted states and communities in Region 2 through coordination with the Disaster Recovery and Mitigation Workgroup. (CEPD and SPO)
  - Measure/Metric/Target: Work with communities in R2 to showcase integrating stormwater management and energy resiliency into their adaptation efforts. In addition, in FY '22, continue to participate in monthly RSFLAG Caribbean energy subgroup meetings and pilot energy efficiency and nature-based solutions in at least 1-2 Region 2 communities.
  - Vulnerability Addressed: Public health and environmental justice
  - Strategic Plan Linkage: Objective 5.3, Objective 6.3
  - Adaptation Plan Linkage: Priority 2
  - Co-Benefits:
  - Resources: Requires additional resources

- Support and develop internal capacity/workforce to develop and implement disaster mitigation, response, and recovery initiatives in Region 2, in particular, for the Caribbean. (ALL DIVISIONS)
  - Measure/Metric/Target: In FY 22, the WD will transfer one FTE to CEPD in order to better coordinate EPA's drinking water program in Puerto Rico. Drinking water is currently threatened by extreme weather that can go from droughts to floods. WD will continue to provide support to CEPD to support drinking water protection from climate threats in FY 23.

  - Vulnerability Addressed: Water infrastructure capacity; solid waste infrastructure; water quality and quantity in estuaries and wetlands; drinking water quality; sewers and wastewater systems
  - Strategic Plan Linkage: Goal 5 Obj. 5.1; Goal 6 Obj 6.3
  - Adaptation Plan Linkage: Priority 3
  - Co-Benefits:
  - Resources: Requires additional resources

- Expand inter-agency partnerships to support disaster mitigation activities in those communities and facilities most at risk to climate impacts. (SPO)
  - Measure/Metric/Target: Meet with inter-agency partners on disaster mitigation topics at least 3 times per year.
  - Vulnerability Addressed:
  - Strategic Plan Linkage:
  - Adaptation Plan Linkage: Priority 2
  - Co-Benefits:
  - Resources: Uses current resources

- Work along with Puerto Rico and US Virgin Islands governments and federal partners such as FEMA and HUD to recognize coral reefs, beaches, wetlands, mangroves, dunes, and seagrass meadows as critical infrastructure (CEPD, ORC)
  - Measure/Metric/Target:
  - Vulnerability Addressed:
  - Strategic Plan Linkage:
  - Adaptation Plan Linkage: Priority 2
  - Co-Benefits: Public health and environmental justice
  - Resources: Requires additional resources

Theme 5: Use our Authorities to Innovate and Expand our Work on Climate Adaptation

Region 2 has identified the following 5 priority actions under this theme:

- Research statutes and regulations that provide discretion for Region 2 to advance adaptation and feed the knowledge we gain/lessons-learned into the broader national effort on climate change. (ORC)
  - Measure/Metric/Target: In FY ’22, formulate an internal plan to research the statutes and regulations in conjunction with our participation on the OGC Climate Change Legal Workgroup.
  - Vulnerability Addressed: Potentially All
  - Strategic Plan Linkage: Goal 3
  - Adaptation Plan Linkage: Priority 1
  - Co-Benefits: Protection of public health
  - Resources: Requires additional resources

- Focus regional compliance monitoring activities on sources where compliance with new and/or existing regulations will have the co-benefit of mitigating/adapting to a changing climate (e.g., volatile organic compound inspections in non-attainment areas, CAA New Source Performance Standard inspections at landfills, or stormwater inspections in flood zones), especially where such activities will advance environmental justice. (ECAD)
    - Measure/Metric/Target: In FY '22, work with OECA and other Regional ECADs to determine best method of tracking climate change adaptation related inspections. In FY '23, begin tracking such inspections and work with OECA/other Regional ECADs to incorporate climate change considerations into National Compliance Initiatives.
    - Vulnerability Addressed: Actions will help in addressing all known Region 2 vulnerabilities including human health; sewers and wastewater systems; septic systems; wetlands; water quality; overburdened communities; tropospheric ozone pollution; particulate matter; risk of and response to contaminant releases; and use of and exposure to toxic chemicals.
    - Strategic Plan Linkage: Goal 3.2
    - Adaptation Plan Linkage: Priority 1 and 2
    - Co-Benefits: Mitigation of greenhouse gases and other pollution; public health; and environmental justice
    - Resources: Need additional resources

- Factor in climate change adaptation into enforcement actions/settlements, such as promoting green infrastructure as part of injunctive relief in NPDES stormwater cases. (ECAD and ORC)
    - Measure/Metric/Target: In 2022 Highlight opportunities to incorporate climate change adaptation into enforcement actions/settlements to at least 85% of inspectors/enforcement attorneys. In 2023, work with ECADs and OECA to develop formal climate change adaptation enforcement training.
    - Vulnerability Addressed: Actions will help in addressing all known Region 2 vulnerabilities including human health; sewers and wastewater systems; septic systems; wetlands; water quality; overburdened communities; tropospheric ozone pollution; particulate matter; risk of and response to contaminant releases; and use of and exposure to toxic chemicals.
    - Strategic Plan Linkage: Goal 3.1
    - Adaptation Plan Linkage: Priority 1
    - Co-Benefits: GHG mitigation; public health; environmental justice
    - Resources: Requires additional resources

- Advance adaptation in our permitting actions (ORC)
    - Measure/Metric/Target: In FY '22, meet with at least two of Region 2's program offices to explore opportunities to incorporate adaptation into permitting in addition to supporting all program offices as opportunities arise.
    - Vulnerability Addressed: Potentially All
    - Strategic Plan Linkage: Goal 3
    - Adaptation Plan Linkage: Priority 1
    - Co-Benefits: GHG mitigation; Protection of public health; Environmental justice
    - Resources: Requires additional resources

- Coordination with state, local and federal agencies to ensure consideration of hazards and vulnerabilities resulting from climate change are adequately incorporated in NEPA documents. Various adaptations can range from behavioral, management/operations to infrastructural/physical. The range of alternatives should be expanded to include such recommendations (SPO)
    - Measure/Metric/Target: Engage on climate hazards and vulnerabilities with state and federal partners on 3 projects
    - Vulnerability Addressed:
    - Strategic Plan Linkage:
    - Adaptation Plan Linkage: Priority 2
    - Co-Benefits:
    - Resources: Uses current resources

Theme 6: Maintaining Facilities and Operations

Region 2 has identified the following 3 priority actions under this theme:

- Maintain Utilities (energy, water, gas) required for facility operation
    - Measure/Metric/Target: Continuing operational utilities for EPA facilities
    - Vulnerability Addressed: Utility loss
    - Strategic Plan Linkage: Develop plans with local utilities
    - Adaptation Plan Linkage: Priority 2
    - Co-Benefits:
    - Resources: Uses current resources

- Provide working space for base operations
    - Measure/Metric/Target: Providing a viable working environment
    - Vulnerability Addressed: Loss of base operations
    - Strategic Plan Linkage: Develop strategies for obtaining and maintaining office areas for base operations.
    - Adaptation Plan Linkage: Priority 2
    - Co-Benefits:
    - Resources: Use current resources

- Maintain communications and technological connectivity
    - Measure/Metric/Target:
    - Strategic Plan Linkage: Develop contingencies to maintain off-site communications and remote work locations
    - Vulnerability Addressed: Loss of off-site productivity and computer communication links.
    - Adaptation Plan Linkage: Priority 2
    - Co-Benefits:
    - Resources: Use current resources.

5. Training Plan for Enhancing Staff Knowledge About Climate Adaptation

Training on climate change impacts and adaptation is a key element of building capacity for adaptation within Region 2. The Region plans to enhance staff, management and partner awareness and knowledge of relevant climate impacts and climate adaptation approaches.

In FY '22, Region 2 will offer to all staff within the Region a Climate 101 training to be developed and finalized by the Office of Policy as well as other training listed in the table below, if it becomes available prior to the end of the fiscal year. Region 2 will also initiate an internal speaker series on adaptation and disaster mitigation in FY '22 for EPA staff with the goal of having two sessions before the end of the fiscal year that feature panelists presenting on behalf of our governmental partners. Region 2's Water Division, in consultation with the Strategic Programs Office, will also plan to launch an educational initiative to increase water-related climate literacy and information exchange. The Region's Superfund and Emergency Management Division will provide one internal training for its staff in FY' 22 on climate change adaptation and site remedy resiliency.

In FY '23, Region 2 will offer its staff from each Division the opportunity to participate in program-specific training relative to their Division to the extent that it is developed by their counterpart Headquarters program office and ready for distribution before the end of FY '23 (see Headquarters schedule in Table 1, below). The Region will also build upon its speaker series on adaptation and disaster mitigation by hosting four additional internal presentations.

Table 1

Climate Adaptation Training / Webinar Module by Lead Office or Region 2	Tentative Date Modules will be Available	Tentative R2 Administration Dates	Targeted R2 Staff to be Trained
Office of Policy (OP) Climate Adaptation 101	Summer 2022	Fall 2022, Fall 2023, Fall 2024	All R2 Employees
Regulation Writers	End of 2022	Spring 2023, Spring 2024	All R2 Employees
Office of Water (OW)	End of 2022	Spring 2023, Spring 2024	WD
Office of Land and Emergency Management (OLEM)	End of 2022	Spring 2023, Spring 2024	LCRD & SEMD
Office of Air and Radiation (OAR)	End of 2023	Spring 2024	ARD
Office of Chemical Safety and Pollution Prevention (OCSPP)	End of 2023	Spring 2024	LCRD
Office of Enforcement and Compliance Assurance (OECA)	End of 2023	Spring 2024	ECAD plus credentialed inspectors in other Divisions and ORC
Office of Mission Support (OMS)	End of 2023	Spring 2024	MSD
Office of Homeland Security (OHS)	End of 2023	Summer 2024	All R2 Employees
Office of International and Tribal Affairs (OITA)	End of 2023	Summer 2024	All R2 Employees
Office of Research and Development (ORD)	End of 2023	Summer 2024	All R2 Employees
Water Division – R2 Water-related educational initiatives	Fall of 2022	Fall 2022	R2 Employees & EJ Communities
SEMD – R2 Climate Change Adaptation and Site Remedy Resiliency	Summer / Fall 2021	Summer / Fall 2021	SEMD Staff
ECAD – R2 Modernization Field Activities Sites Training	Spring 2022	Spring 2022	ECAD Staff

6. Climate Science Needs

Region 2's overarching science need is a tool that integrates sea level rise, storm surge, high tides and extreme rainfall so that we can better make decisions and assist the communities in our Region based on the total water-related impacts of storms. This is particularly relevant to Region 2 given the climate-related increased intensity of hurricanes and Nor'easters in the Caribbean and Northeast. Tools that have a simplified user interface for local planning within communities would be particularly helpful. If there are existing tools that provide the total water-related impacts, Region 2 would like assistance with understanding which tool to use in a given circumstance so that the Region can most effectively incorporate decisions across-the-board. This information could impact many decisions in the Region, from Superfund remedial actions to Clean Air Act permitting and Clean Water Act enforcement cases as well as community engagement and assistance.

Other Region 2 science needs include:

1. Wetland and Stream Restoration and Preservation - Climate change is predicted to increase coastal and inland flooding, increase the severity and the frequency storm events, and cause a rise in global sea level resulting in erosion of coastal and riparian areas and periodic inundation of low lying, coastal, and/or riparian areas. Using wetlands and streams to mitigate these adverse effects can increase climate resilience. There are two categories of science needs associated with this item:

    a. **The first category of science need** is to have 1) accurate sea level rise projection tools; 2) existing floodplain, floodplain migration, and marsh migration geospatial data; and 3) mapping that can be used to consider siting of wetland and stream restoration and preservation to help buffer against the effects of flooding and storm surges. Further support for wetlands restoration could come from the GHG sequestration potential of restored wetlands. A tool for calculating this potential would be helpful. The science to effectively design and evaluate the ecosystem and community protection of living shorelines can also increase climate resilience.

    b. **The second category of need** is to evaluate potential impacts of climate change on the health of existing wetland habitats. Healthy wetlands will not only protect land from winds, flooding and storm surges, but also protect other coastal and marine habitats (e.g., coral reefs) from land-based pollution. Overall, wetlands improve water quality, protecting aquatic life from excess carbon, nutrients and sediments. Wetlands are reservoirs of biodiversity often including threatened and/or endangered species. This information will be used to assist with wetlands restoration, preservation and resilience.

2. Harmful Algal Blooms (HABs)/Water Quality - blue-green algae or cyanobacteria, HABs can produce dangerous toxins, such as microcystins and cylindrospermopsin, that can sicken or kill people and animals, raise treatment costs for drinking water, and cause dead zones in water bodies.

    a. **The science need** is to 1) improve analytical methods for measurement and monitoring of toxics related to HABs in freshwater systems; 2) track the presence of

cyanobacteria-producing toxins; 3) assess ecosystem response and recovery to changing nutrient loads; 4) assess effects of exposure to cyanobacterial toxins on wildlife and humans; 5) optimize treatment methods (e.g. activate carbon filtration) to remove cyanobacterial toxins; 6) understand nutrients in a changing climate (e.g. hypoxia); 7) examine coastal acidification.

3. Green Infrastructure - encouraging the use of green infrastructure (GI) practices a sustainable mechanism to manage stormwater, treating it as a resource rather than a waste product. There are multiple benefits associated with GI, such as improved habitat and reduced heat island effects.

a. **The science need** is for continued research regarding design efficiency and optimizing locations. Economic research on lifecycle costs and maintenance is needed. The quantification and the valuation of co-benefits is important to support promoting the expanded use of GI.

4. Superfund – Due to climate change and the resulting increase of major storm events leading to inland and coastal flooding and increased temperatures (i.e. excessive heat) there is a need for RPMs to consider potential site and remediation system vulnerabilities. This would include remedial actions under consideration, under construction or already in place. Implementing remedy resilience measures would ensure that the cleanup of sites would be less affected by climate change.

a. **The science needs** are as follows: 1) guidance on updated and expanded green remediation metrics that would improve mitigation efforts of cleanups, 2) further development of flood mapping tools and development of tools related to other climate risks (i.e., sea level rise projection) so that assessments can be taken a step further for use in conducting a ranking exercise of site vulnerabilities, 3) ongoing training for RPMs on the use of these tools and 4) development of a website where RPM's can find tools, guidance, training and other resources all in one place to make decisions at their site regarding potential climate change issues.

5. Modeling the Impacts of Climate Change – predicting the impacts of climate change will help develop strategy and policy to improve and protect recreational waters and drinking water supplies. The water quality impacts of climate change can be modeled by linking regional global climate, watershed landside and receiving water quality models. This suite of models can be used to address potential impacts of climate change on water supply systems such as: increased nutrient loading; longer lake stratification periods; increased sediment erosion; and dominance of cyanobacteria. In addition, climate change may also increase pathogen levels and disinfection byproduct precursors. An application of the modeling framework would be to mechanistically represent the production of microcystins in future climate scenarios and develop appropriate nutrient reduction strategies. There are two categories of research needs associated with this item:

a. **The first science need** is to inventory and evaluate modeling methods that support our programs; build technical capabilities of staff to execute modeling projections; and procure computing space needed to run such models, as needed.

b. **The second science need** is to continue research regarding production of microcystins from nutrient loadings to be able to develop modeling predictions.

In addition, Region 2 has several project/initiatives in common with other EPA Regions/offices and Agencies that connect with science needs. Region 2 is working with EPA Region 1, and the States of New York and Connecticut on the Long Island Sound Study (LISS) to restore and protect the health of Long Island Sound. Science research questions sometimes arise in the context of the LISS partnership that might benefit from additional support. Region 2 is working with NOAA's Ocean Acidification Project on research on monitoring coastal wetlands and sentinel monitoring related to climate change. This effort might require some additional research support from ORD. Region 2 is also exploring opportunities to collaborate with Regions 3 and 1 on a project they initiated on "blue carbon" resources such as wetlands, tidal marshes, and sea grass that represent potential climate change adaptation, mitigation, and coastal resilience solutions for communities. Region 2 is also participating discussions with Regions 10 and 9 and ORD on island-specific issues and is exploring potential research-related resources identified by ORD. In addition, Region 2 (along with Region 3) is a member of the Mid-Atlantic Federal Climate Partners which could present opportunities for cross-Agency collaboration on science needs.